

**Fish Habitat Protection and Planning for
Forest Harvesting in Coastal Streams
of British Columbia: Some Research
and Management Implications**

G. F. Hartman, J. C. Scrivener, M. J. Brownlee,
and D. C. Morrison

Department of Fisheries and Oceans
Fisheries Research Branch
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

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FISH HABITAT PROTECTION AND PLANNING FOR FOREST HARVESTING
IN COASTAL STREAMS OF BRITISH COLUMBIA:
SOME RESEARCH AND MANAGEMENT IMPLICATIONS

by

G. F. Hartman, J. C. Scrivener, M. J. Brownlee, and D. C. Morrison¹

Department of Fisheries and Oceans
Fisheries Research Branch
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Nanaimo, British Columbia V9R 5K6

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Fish Habitat Protection and Planning for Forest Harvesting
in Coastal Streams of British Columbia: Some Research and
Management Implications

Part I

Some Implications of Carnation Creek
Research Results to the Process of
Forest Planning Guideline and
Protection Clause Review

by

G. F. Hartman and J. C. Scrivener
Department of Fisheries and Oceans,
Pacific Biological Station,
Nanaimo, B.C.

Part II

A Preliminary Fisheries Examination
of the Content, Application and
Administration of the Stream
Protection Clauses ("P" Clauses)
on Vancouver Island

by

M. J. Brownlee and D. C. Morrison¹
Habitat Management Division,
Department of Fisheries and Oceans,
Vancouver, B.C.

¹B.C. Ministry of Environment,
Regional Operations,
Nanaimo, B.C.

FORWARD

In April 1983 a 2 day technical workshop was convened in Parksville, B.C. to afford representatives of the Federal and Provincial Governments and the forest industry an opportunity to review the current coastal forest planning guidelines. The objective of this meeting was to examine the compatibility of existing environmental constraints on logging with current research results from Carnation Creek and other sources and to recommend improvements, if necessary on the Guidelines and/or their administration.

The two papers in this report were prepared as part of the background discussion documents for this workshop. The papers have been published "in tandem" in this series because they address several related aspects of current fisheries-forestry research and their respective management adjacent to small streams. As this topic will be the subject of a rather intensive review over the forthcoming months the authors would welcome any comments or suggested revisions on any aspects of the content of these documents.

ABSTRACT

Hartman, G. F., J. C. Scrivener, M. J. Brownlee, and D. C. Morrison. 1983.
Fish habitat protection and planning for forest harvesting in coastal
streams of British Columbia: some research and management implications.
Can. Ind. Rep. Fish. Aquat. Sci. 143: v + 73 p.

The first of the two parts of this report reviews some of the major results emerging from the Carnation Creek Watershed Study. The paper considers the implication of research results of the British Columbia Coast Forest Planning Guidelines and Protection Clauses. The second part of this report reviews those salient elements of the stream protections clauses, outlines the purpose of these elements and suggests areas for revision. The Appendices include copies of the protection clauses and related management correspondence.

Key words: Carnation Creek, watershed, Forest Management Guidelines, research results

RÉSUMÉ

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streams of British Columbia: some research and management implications.
Can. Ind. Rep. Fish. Aquat. Sci. 143: v + 73 p.

La première des deux parties du présent rapport couvre certains des principaux résultats de l'Étude du bassin-versant du ruisseau Carnation. Les auteurs examinent la portée des résultats de la recherche sur les lignes directrices pour la planification forestière de la côte de la Colombie-Britannique et les dispositions de protection. La seconde partie du rapport présente les éléments saillants des dispositions pour la protection des cours d'eau, ébauche leur but et suggère les points à réviser. Les annexes comprennent des copies des dispositions pour la protection et de la correspondance gestionnelle connexe.

Mots-clés: ruisseau Carnation, bassin-versant, lignes directrices pour la gestion forestière, résultats de la recherche



SOME IMPLICATIONS OF CARNATION
CREEK RESEARCH RESULTS TO THE
PROCESS OF FOREST PLANNING GUIDELINE
AND PROTECTION CLAUSE REVIEW

G.F. Hartman and J.C. Scrivener

Pacific Biological Station

Nanaimo, B.C.

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INTRODUCTION

Much of the work that has been published on extended watershed studies has been carried out in eastern hardwood forest watersheds, in Oregon Douglas fir forest systems, or in colder coastal forest systems of Alaska. In the late 1960's concern about the direct applicability of this forestry-fisheries research led to initiation of the Carnation Creek Experimental Watershed Study. The intent of this study was to obtain information on responses of watersheds and fish populations to logging in coastal British Columbia. This paper will summarize conclusions to date that are most relevant to guidelines and protection clauses applied to coastal logging in B.C.

It will be developed from the base of almost 12 years of work in the Carnation Creek watershed. It will attempt to deal with the following:

1. Synopsis of Study Results.
2. Principle physical responses in light, temperature, nutrients, hydrology, debris, sediment, and channel morphology. The effects of forest harvest practices, streamside treatments and cutblock size on these and some implications of planning guidelines.
3. Elements of fish production in the mainstem, in tributary side channels, and in the estuary.
4. Major population processes and changes for salmon and trout.
5. Discussion of study results, forest planning guidelines, the limitations and strengths of the Carnation Creek study, and processes and problems requiring further research.

THE CARNATION CREEK STUDY

The Carnation Creek Watershed study, begun in 1970, is a multi-disciplinary study of a 10 km² rain forest watershed on the west coast of Vancouver Island. The lower 3 km of stream are used by Coho and Chum salmon and Steelehead trout spawners. Cutthroat trout are found predominantly in the upper reaches.

The region is characterized by heavy rainfall (2150 to 3500 mm/yr) and a dense coniferous forest of Hemlock, Cedar, Sitka spruce and Amabilis fir. Little of the precipitation falls as snow. Soils are medium to coarse textured and range from gravelly loam to loamy sand with moderately thick humus horizons. Slope soils are shallow in most areas of the watershed.

The study was designed to compare physical and biological watershed processes during pre-logging (1970-75), during-logging (1975-81) and post-logging (1981-85) phases. This was accomplished by measurements of:

- stream flow, subsurface water movement, precipitation, water and air temperatures and light with an extensive network of hydrometeorological stations;
- chemical inputs and outputs in the watersheds;
- sediment and debris transport and deposition;
- channel morphology and large organic debris changes in annually mapped stream reaches;
- soil disturbance and revegetation after logging;
- stream bed gravel quality changes and its impacts on salmon egg incubation;
- changes in stream algal community and its production;
- changes in aquatic insect populations and their utilization by stream fishes;
- and changes in stream fish migration, movement and general population dynamics.

Timber harvesting began in the winter 1975/76 in a 23 ha opening near the stream mouth. This initiated three basic streamside treatments in the area occupied by salmon and Steelehead trout.

1. Undisturbed streamside treatment - This area was logged as 3 openings during 1975/76(23ha), 1978/79 (19.4ha), and 1980/81 (16ha), and left the lower 1300m of Carnation Creek with a small buffer strip or unlogged canyon area in which deciduous vegetation and a few merchantable trees remained.
2. Intense streamside treatment - The next 900m segment of streamside was logged in 1976/77 as 2 large clearcuts (61,34.4ha). This treatment included pre-logging hand application of Tordon 22K herbicide to girdled alder stems; falling all merchantable timber either away from the channel, or if leaning heavily, across the channel; and then yarding the timber away from the stream to roadside landings.
3. Careful streamside treatment - Both side of the next 900m of streamside was logging as 2 clearcuts (63,13ha) during 1978/79. Here, minor vegetation such as salmonberry was left; 6 merchantable trees which could not be jacked or cabled were felled across the channel and removed; and alder was later felled and piled for burning during scarification.

Unfortunately, because of topography, the intense treatment was upstream of the first treatment. Therefore, downstream effects were

observed in the segment of undisturbed streamside.

Upon completion of the 6 year logging and forestry plan in 1981, 41% of the watershed had been logged. Of the clearcut area 25% had been broadcast slash-burned and 2.5% had been scarified. The valley bottom had been planted in sitka spruce and red cedar, the slopes planted with Douglas fir and fir. Natural hemlock seeding has also occurred on the slopes.

SYNOPSIS OF RESULTS

Two important generalizations can be made about the nature of population regulation and the impacts of logging on salmon and trout. The first is energy related and the second is habitat related.

Opening of the canopy over the stream tended to improve the rate of energy introduction to and transfer through the biological community in the stream. As a result, microbial respiration, total primary production, densities of benthos, drift of food organisms, and growth and densities of predators including salmonids can all increase. These impacts are the result of increased light penetration, water temperatures and dissolved nutrients in the stream. This can be most pronounced in streams like Carnation Creek which in their pristine state are cold, heavily shaded, flashy and oligotrophic. These positive impacts are less pronounced or can be detrimental impacts for streams in which temperatures and nutrient loads are initially higher. As revegetation and a second growth forest develops, nutrient loading and direct energy inputs rapidly decline.

Watershed and streamside disturbance tended to generate a spectrum of physical habitat changes which produced negative impacts on the biological community in the stream. Streamside disturbance destabilized or broke up large organic debris. As a result channel and bed morphology changed extensively during major freshets. Stream banks were eroded and suspended sediment and bed load movement increased. As a result salmonid egg to fry survival and benthic food organism densities declined in the gravel. Coho fry densities also declined within the stream reaches which were affected. These changes did not begin until two years after the initiation of logging. In low gradient, flashy and boulderless streams like Carnation Creek, large woody debris maintains the stability of riffles and pools; armors the banks; and forms the necessary fish cover. The time frame for mitigation of these kinds of changes is much longer than those which are energy related.

RESPONSES IN PHYSICAL PROCESSES

Hartman and Holtby (1982) have summarized the principal responses for six physical conditions in the stream and attempted to show how changes in the physical processes have affected coho salmon production. These changes and impacts are summarized in table I and are discussed in the following text.

LIGHT AND TEMPERATURE REGIMES

The impact of streamside forest removal has contributed to higher summer temperature conditions (Holtby and Newcombe 1982), and greater light penetration (Stockner and Shortreed 1976). The moderate summer temperature increases noted to date appear to be beneficial to production of coho salmon in the stream (Hartman et al., In press). These positive influences tend to diminish within a few years as the stream encloses in the second growth forest.

The Carnation Creek work indicates that up-slope cutting and slash burning also generates increases in winter stream temperature regimes (Hartman et al., In press; Holtby and Newcombe 1982). These changes appear to be at least partly caused by changes in groundwater temperature. The effects of increased stream temperatures, during winter, are complex. They appear to occur for only a few years after logging. They confer benefits of an early growth start-up for fry, but expose them to risks of dislocation associated with freshets which are more frequent in early spring (Hartman et al 1982; Hartman et al., In press). As a result of this phenomenon few fry still remained in the stream by May of 1981 and 1982.

NUTRIENT REGIMES

Scrivener (1975 and 1982) has documented a number of changes, associated with forest harvest, in the hydro-chemical balance of the stream. These changes (summarized in Table 1) are mainly related to increased nutrient release due to disturbance (slash-burning) and are essentially beneficial to production of algae and invertebrates. Nutrient levels increased during the summer growth period for algae and stream invertebrates (Stocker and Shortreed 1976; Culp and Davies 1982), but the largest increase occurred during autumn freshets when it was of little value to stream life. Within 15 years, as the second growth forest develops, nutrients in the stream will probably return to levels at least as low as those found before logging.

HYDROLOGICAL REGIME

In watersheds with the characteristics of Carnation Creek, forest harvest may not create major disturbances that are reflected in hydrological regimes. At present no statistically significant increase in water yield has been demonstrated and the relationship between peak precipitation and peak discharge events has not changed in a statistically demonstrable degree (Hetherington 1982). However, the freshet responses during rain on snow events have not been rigorously analysed. There are several features of the hydrological regime in Carnation Creek (Table 1) that have special implications to road construction location, the method of yarding logs, and to summer rearing for fish in small side tributaries and back channels.

During storms, a large fraction of the run-off water moves through macro-channels in the thin slope soils of the watershed. In H-tributary road construction, soil compaction and ditch construction

re-directed flows to the stream (Hetherington 1982). There is a potential for debris and sediment movement with such flow re-direction. Log removal methods that compact the soils and seal off the macro-channels can lead to higher levels of saturation in slope soils during storms (Hetherington 1982). This kind of change in water transport has the potential to affect over-land run-off, mass-wasting and hence erosion. Although increases in saturated soil depth have not led to many mass-wasting situations in the shallow soils of Carnation Creek, such increases may be important to forest managers when dealing with deeper soils on similarly steep slopes.

Elevated groundwater levels in the valley floor which have been recorded in the alluvial flood plain during summer, are considered to be an advantage to fish living in small side tributaries and back-channels. However, such higher groundwater levels do cause problems for re-forestation (Hetherington 1982).

The most evident management and protection problems that have occurred in the watershed, with the treatments applied have not necessarily involved major changes in the hydrological regimes themselves (Table I). The problems, debris movement, channel destabilization, bedload movement, sediment movement and gravel quality change have all been associated with hydrological energy however.

DEBRIS, CHANNEL MORPHOLOGY AND SEDIMENT CONDITIONS

In the intensive treatment area of the stream, from about 1300 m to 2250 m upstream from the mouth; debris has become less stable and reduced in volume (Toews and Moore 1982). The large organic debris formed and maintained many of the food producing riffles and fish pools in this section. As a result of debris loss, subsequent freshets channelized many segments by eroding streambanks, by filling in pools, and by straightening the channel. This produced less useful summer and winter fish habitat (Scrivener and Andersen 1982). In the careful treatment area, immediately above 2250 m, large debris has moved noticeably during the last two winters and the channel is eroding in several locations. Logging debris entering the channel during freshets has appeared to destabilize instream debris. In sections of stream with alluvial flats, the careful treatment may be inadequate to prevent bank loss unless enough logging debris is removed from the flood plain.

In Carnation Creek, sand has been accumulating in the top layer of the bed since 1978 (Scrivener and Brownlee 1982). As a result, gravel quality and salmon egg survival have declined. The source of this sand is the eroding stream banks within the intense streamside treatment which is 1.4 to 2.2 km upstream of the lowest site sampled. Since sand and bedload material, released at one location, may influence downstream sites up to 2.2 km away in the mainstem of a small stream like Carnation Creek, it is probable that high gradient non-fish tributaries will transport sand downstream into salmon habitat. In some small tributaries sediment settles out as an alluvial fan at the base of the slope and the tributary crosses the alluvial flats before it joins the mainstem. Other tributaries flow directly into Carnation Creek and transport their total loads into the mainstem.

FISH PRODUCTION IN THE MAINSTEM,
SIDE CHANNELS AND ESTUARY
OF CARNATION CREEK

Trout and salmon utilize the mainstem, small side tributaries and estuary. Some habitat components are only used by certain species or a specific life history stage. Table II summarizes and comments on the impacts of seven physical changes attributed to logging on six salmonid life history stages in A. mainstem, B. side channels and C. estuary.

The use of diverse habitat components offers salmon a wider series of life history strategies. This can provide a greater overall probability of survival for populations which must withstand wide annual and seasonal variations in their environment. A major part of the egg incubation and fish production occurs in the mainstem of the stream. However, fish may move from the mainstem to the estuary, side channels and small tributaries for summer or winter rearing.

P. Tschaplinski (1982) has documented important features of estuary biology of the coho fry. The estuary offers to a limited number of coho fry, which have moved downstream, an option for rapid growth, and possibly, migration to sea in the first fall. Use of side tributaries offers the fish an option for use of extra space and a chance to avoid winter freshet conditions of the stream's mainstem (Bustard and Narver 1975a; Peterson 1980; Tschaplinski and Hartman 1983), but exposes them to the possibility of stranding during a dry year.

Table II, indicates that changes in physical conditions in the watershed, based on this study, may be positive, negative, nil or unknown. The physical changes that affect one life stage may not have the same impact on another life stage. Moderate changes in a condition, e.g. temperature, may have a positive effect on a life stage while major change in the same condition may be clearly adverse to fish. Changes that cause problems for fish in one habitat component may not do so or indeed may not occur, in another, e.g. large organic debris is critical as over-winter cover for fry in the mainstem, but can be less important in back-water swamps or side channels.

In Table III an attempt was made to list the Forest Harvest planning guidelines and P-1 clauses that would have an effect in controlling the physical changes that may have an impact on fish in the three components of the watershed listed. Wording of the guidelines and "P" clauses are in the Appendix. Because so many processes in a watershed are interdependent, and because some of the planning guidelines are stated so generally, any life stage of a fish may be subject to the considerations of many planning guidelines. It is also noted that the majority of clauses emphasize impacts on stream morphology and sedimentation, but few pertain to the estuary environment (Table III).

POPULATIONS CHANGES - SALMON AND TROUT

This section of the paper will point out some of the most obvious changes in fish production patterns from 1970 to 1981 and discuss them in relation to changes within the stream.

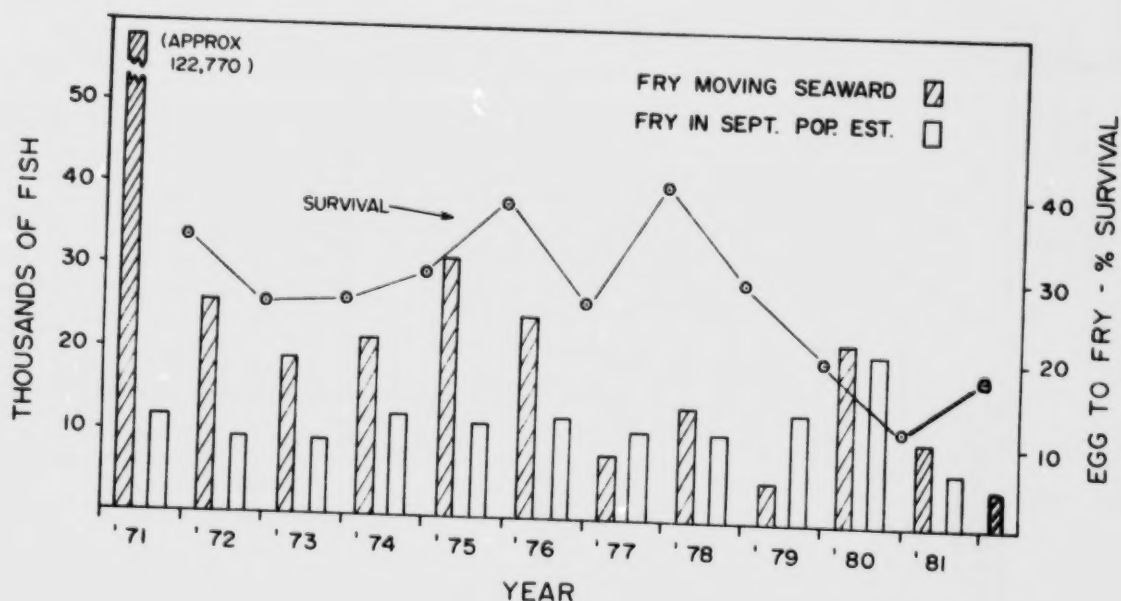


Fig. 1. The egg-to-fry survival rate, the numbers of coho fry moving seaward and the numbers of fry in the September population estimate, 1971 to 1982.

Holtby and Hartman (1982) have prepared an extensive analysis of coho salmon population dynamics in Carnation Creek. A summary of the most obvious changes are outlined here. Coho egg-to-fry survival has declined since the winter of 1977-78 (Fig. 1). With the exception of 1980, the number of fry moving seaward has also been relatively low each year since 1977 (Fig. 1). This is probably the result of lower numbers emerging from the gravel. The number of fry moving seaward was exceptionally high in 1971 and has never approached that level since. The number of coho smolts leaving the system was higher in each of the years 1978 to 1982 than in any of the preceding years (Fig. 2). Total adult returns were high between 1978 and 1980, but adult females were high only during 1979 (Fig. 3). The relatively large post-logging fry movement in 1980 is attributed to this large egg deposition in autumn 1979. Holtby and Hartman (1982) have examined smolt production level and year-class structure in order to relate it to adult returns. A non-linear density dependent relationship was obtained between adult returns and smolt production.

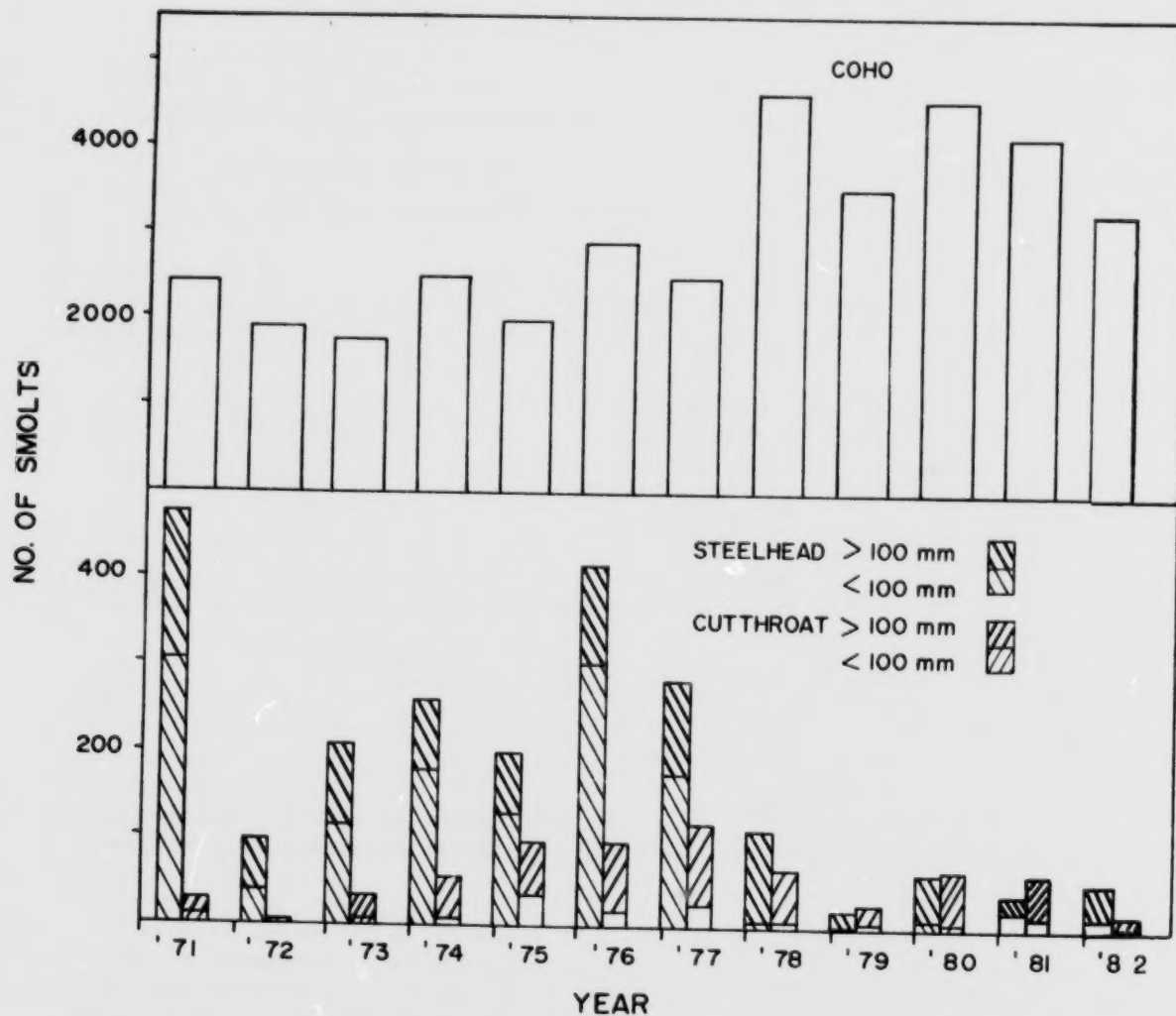


Fig. 2. The numbers of coho, cutthroat and steelhead smolts moving seaward, 1971 to 1982.

Chum egg-to-fry survival also appeared to decline after 1977-78, but results are complicated by 1980/81 survivals which were similar to some pre-logging values (Scrivener and Brownlee 1982). The numbers of adult chum salmon returning fluctuated between 450 and 4200, but they did not show any clear pattern of increase or decrease since 1977-78 (Fig. 3).

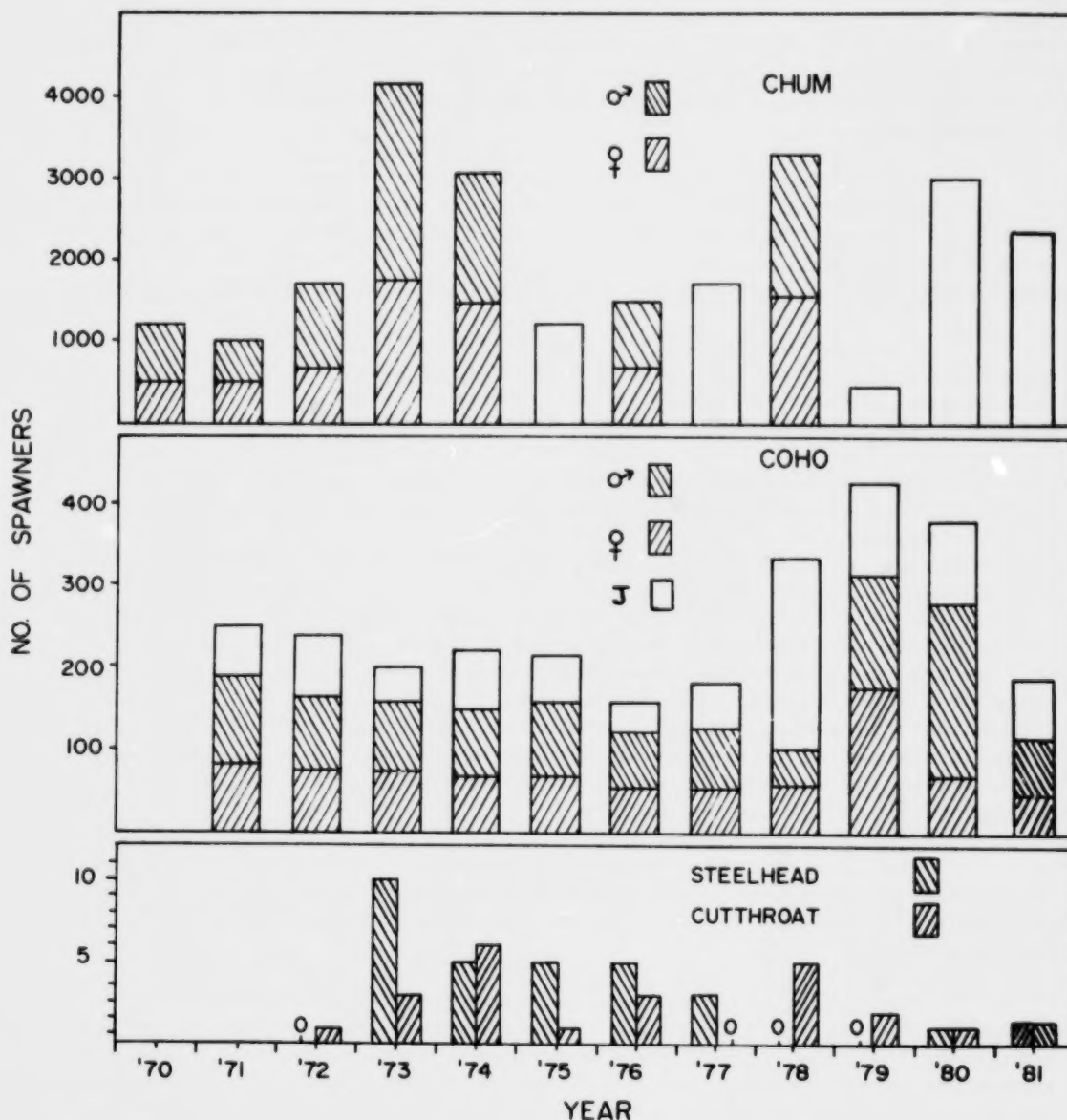


Fig. 3. The numbers of adult chum, coho and trout entering the stream. Most chum salmon do not pass through the fence. Their numbers are estimated and are not precise. The trap did not operate throughout the period of trout migration during some years. Trout numbers are therefore minimal.

While the numbers of seaward-moving steelhead and cutthroat trout are variable over the total period 1971 to 1980, they appear to have decreased after 1977 (Fig. 2). Further evidence of trout population decline is provided by the instream population censuses. The total number of trout, estimated during the September population censuses, varied from 2000 to 5500 between 1971 and 1976 (Fig. 4). They dropped sharply after 1976. In addition to this, the fraction of the summer resident trout population, that is made up of cutthroat, has increased (Fig. 4). At this stage of the study, we do not understand the mechanisms underlying the trout population changes.

The numbers of adult trout sampled have decreased (Fig. 3). However, sampling for trout at the counting fence during recent years does not extend through their full period of possible migration. The numbers are not as meaningful as would be the case if a complete count was obtained. However, numbers of emerging fry are lower during recent years.

A number of the major processes that affect coho numbers from egg to smolt and that lie behind the changes in abundance of different life stages, 1971 to 1981, are better understood (Holtby and Hartman 1982; Scrivener and Andersen 1982; Hartman et al., In press).

The first major change that has occurred since the winter of 1977-78 is the decline in egg-to-fry survival and the reduction in numbers of early migrant fry (Fig. 1). The evidence strongly indicates that these changes are related to changes in spawning gravel quality and bed-load movement. These changes are attributed in large measure to bank erosion and slumping in the area in which timber was felled across the stream and then yarded out. The breakup of large stable debris, the loss of live tree root structures in the streambanks and freshets within the range of the pre-logging experience, contributed to the erosion process. Streamside treatment and logging methods are critical with regard to this first life stage of young coho and young chum salmon as well. The impacts which affect egg survival in the lower creek are generated by harvest treatments up to 2.4 km upstream.

From the 1976-77 winter until 1980-81 the general climate that influenced the Carnation Creek system was milder. Discharge conditions were generally less severe and stream temperatures were higher (Hartman and Holtby 1982).

The result of warmer stream temperatures has been much earlier emergence of coho fry. There are advantages and disadvantages of such a change for the coho fry. The early emergence allows the fish to begin spring and summer feeding and growth earlier. This allows them to enter their first winter as larger fish, which has an overwinter survival advantage.

However, shortly after emergence many coho fry drift downstream coincident with freshets. Among fry emerging late in the winter or in the early spring this response to freshets often occurs before competitive pressure from siblings can take place. In Carnation Creek the winter storms and freshets persist until later March and early April (Hartman et al. 1982).

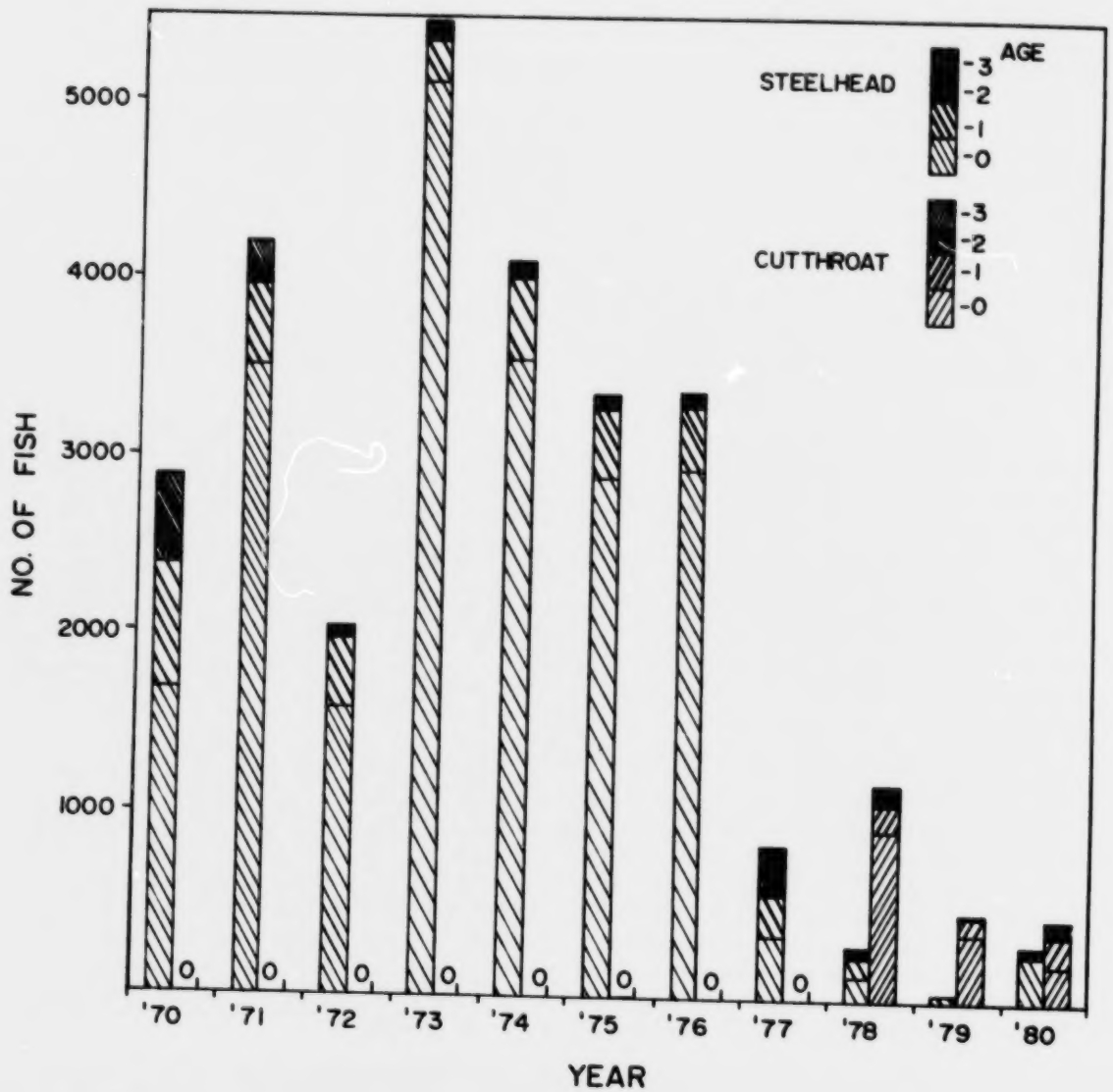


Fig. 4. The numbers and age composition of cutthroat and steelhead trout in the lower 3070 m of the stream in the September population estimate.

The fish emerging early, i.e., March 1 to 30, as a result of accelerated development, are at risk of being flushed from the creek. Although, some rear in the estuary (Tschaplinski 1982), very few work their way back upstream. The during-logging coho fry that remained in the stream generally began growing sooner each spring and grew more rapidly than pre-logging fry. This appears to be the result of the positive role of increased energy input to the stream. However, the processes do not appear to be the same for fish in the second summer in the stream. Here, the negative role of habitat degradation has probably contributed its influence.

Since the clearcutting began in the watershed the number of coho smolts going to sea has increased distinctly (Fig. 2). The higher smolt production 1978 to 1981, is largely the result of high survival of coho from the 0+ to the 1+ stage, at which most now migrate as smolts. A review of fish stream conditions and fish population conditions suggests that two major factors contribute to this. Winter freshet conditions were less severe and water temperatures were higher during the three winters, 1977-78 to 1979-80. The fry of the year entering these milder winters were larger on the average. Among these first year fry, overwinter survival is positively correlated with size (Holtby and Hartman 1982).

With regard to the 1 year plus coho, that do not leave as smolts, summer growth, in comparison with that of pre-logging fish, is not so rapid. Percent survival in this group during the second winter in the stream has declined during the past 7 years. It has not been determined what processes in the watershed may account for this observed decline. However, Bustard and Narver (1975b) demonstrated differences in the distributional responses of 0+ and 1+ coho over a range of falling winter temperatures. The behavior and requirements of the two-year-classes may be different enough to affect survival rates in a changing environment. Bustard and Narver (1975a) demonstrated that age 1+ coho occupied the deepest water at low stream temperatures. Maximum depth of the stream has generally shown a pattern of decrease since the summer of 1978 (Schultz Int. 1981). This general pattern is evident in Sections II to VII, but it does not occur in Section VIII. It is possible that pool depth changes are altering winter survival rates for 1+ coho; this is speculative however. An alternative explanation of the apparent decline in overwinter survival to the 2+ smolt stage is that recently more of these fish have moved seaward during winter rather than during the following spring. Although the fate of the coho that remain in the stream for a second winter after hatching is not known, it is clear that there has been a major change in the ratio of one to two-year-old smolts. A very large majority of the coho now exit from the mainstem as 1+ smolts (Holtby and Hartman 1982 ; Hartman et al., In press).

In summary, the changes associated with logging and with 4 milder winters have had a spectrum of effects, both positive and negative, on growth and survival of young coho salmon. The changes are important to the determination of the returns of fish as adults. It is anticipated that as the physical conditions in the watershed begin reverting to those observed during pre-logging years, so will the coho population parameters. It should be emphasized here that these physical conditions fall into two generalized categories as outlined in the "Synopsis of Results". Each has different recovery timetables.

DISCUSSION

CARNATION CREEK RESULTS

The different components of the forest harvest process and the post-harvest treatments have, as outlined by Hartman and Holtby (1982), a spectrum of effects on a watershed. Some effects, such as the changes in light, temperature and nutrient loading may have a positive influence on algae, benthos and fish production for as long as 15 years. As such the forest practices associated with them are for the manager, useful options. Other effects, such as changes in debris stability, channel form and sediment regimes may leave negative effects which operate over a longer time span (Scrivener and Andersen 1982). They are most pronounced in low gradient streams where mechanical energy may not be adequate to transport introduced fines which then accumulate in the gravel; or in streams like Carnation Creek which are dependent on large woody debris to provide first, channel and bed stability and second, stable cover or surfaces on which stream biota depend. It is essential to recognize that the changes that occur in a watershed do not operate independently, and that if the forest harvest plan does not result in stream-banks, debris and sediment conditions remaining in the same balance as before harvest, the positive effects of light and temperature enhancement which may occur (Table I), can be offset by detrimental physical disturbance in the system.

Managers also recognize the need to consider the potential movement of sand, gravel and debris from feeder streams into mainstem fish habitat. It is important to note that this will depend on the gradient, slope soil type, kind of vegetation, valley bottom topography, logging layout etc.; and therefore will require quite different protection prescriptions for different tributaries.

Increases in winter stream temperatures following logging have not been noted before. In some case histories temperature reductions occurred. Stream aspect, basin shape and structure, and substrate depth may determine the nature of winter temperature responses to logging. This may, at this stage, be a complex and difficult forest harvest consideration. It may be one that managers will wish to explore much further in the future.

FOREST PLANNING GUIDELINES

Forest practice guidelines have been established in Oregon and British Columbia (State of Oregon, Dept. of Forestry 1980, and B.C. Forest Service 1972). Lantz (1971) prepared guidelines for stream protection in logging operations and Moore (1980) wrote a handbook on streamside management decision making procedures. Toews and Brownlee (1980) published an extensive handbook on fish habitat protection and recommended procedures for accomplishing it. Brown (1980) prepared an excellent review of watershed processes and forest harvest impacts on such processes. There is a substantial amount of material available in the form of guidelines, forest practice handbooks and reviews on watershed ecology.

However as the demands for both fish and forest products becomes

more acute it is necessary to continue to review forest management guidelines to produce the best balance of planning elements for both fisheries and forest values. It is also necessary to incorporate as much current watershed process information as possible, based on systems that are as representative of those under management, into the forest harvest planning system.

In any review of the practices of applying coast forest guideline clauses in cutting permits, most research people would agree that their role ought to be to interpret the implications of applying or not applying certain aspects of existing guidelines and protection clauses and to assist the managers in predicting ramifications, to watershed processes and conditions. Research people can also provide managers, who are drafting legislation, with a state-of-the-art understanding of the concepts of, reasons for, and need of stream protection.

Although the planning and protection clauses may have the effect of protecting stream structure in total, if successfully applied, they attempt to satisfy that objective by protecting water quality, reducing debris input, preventing "pollution", etc. Although it is not certain to authors of this paper how, or if the wording could be improved, the guidelines in part appear to be aimed at symptoms rather than at basic problems.

In considering the elements of Table II it is also important to recognize that streams are dynamic systems where natural variations in weather patterns, of which some were experienced in the course of the Carnation Creek work, can cause disturbances similar to those listed in Table II. Therefore, in many cases the application of protection clauses has the objective of minimizing the degree of accentuation of natural fluctuation in a stream system; e.g. sediment movement, debris movement, temperature increase, etc. This leaves the manager with a difficult task of trying to estimate natural fluctuations in the system and of determining the confounding effects between these and the impacts of logging.

LIMITATIONS TO THE CARNATION CREEK STUDY

There are some limits to the direct applicability of this study because there are many forest harvest areas in watersheds that are different in their physical characteristics than Carnation Creek. There are some other limitations to the project due to the design of the study.

Carnation Creek lies in a valley with rocky irregular slopes. The slope soils are shallow and porous. Although the study indicates mechanisms that may operate on the sides of a valley with steep, uniform, deep soil slopes it does not provide the same results that would have been obtained in such an area. In Carnation Creek major physical responses revolve around large debris movement, streambank erosion, and sediment and bedload movement. In the steep slope, deep soil watershed major impacts may have revolved around mass-wasting and sediment input from roads. In areas of the Queen Charlotte Islands or Olympic Peninsula logging roads are the source of most of the sediment entering the stream. Heavy truck traffic pulverizes the soft road surfacing material and these fines are

eroded by surface runoff. At Carnation Creek road building materials tend to be coarser and harder. It should be clear that the managers application of guidelines and P-1 clauses may be tempered by understanding the significance of such differences.

Most of the precipitation that falls in the Carnation Creek Basin falls as rain. The hydrological regime may not show the same responses to clearcutting in these conditions as it does in a valley where much of the precipitation falls as snow. The observations make it clear that findings in Carnation Creek cannot be extrapolated directly to other sites that are climatically or physically different. The watershed processes are similar, but their importance to fish production does vary. The Carnation Creek results should however provide managers with insight into how processes function in different types of watersheds.

There are three design features in the project that limit the quality of data from the study. The cutting plan included cutting in the upper part of the watershed early in the study. The most intensive logging treatment occurred from about 1300 m to about 2250 m upstream. The result of these features of the plan is that impacts are transmitted downstream. Effects of the intensive treatment are in fact passed down into the area in which streamside trees were left. In this situation the differences in responses to the two treatments is obscured. Greater options for comparing tributary responses to treatments would have been available if one large north facing tributary and one small south facing tributary could have been used as controls. Finally, there are monitoring limitations that preclude the partitioning of sediment inputs between road construction and bank erosion. The choice of study area, the design of the study and the emphasis put on certain parts of the work lead to strong understanding of some processes and weaker information about others.

These observations are made about the research not to be critical but to assist managers to interpret the results and to weigh the significance of the presence and absence of certain responses in the watershed.

RESEARCH NEEDS

There is a spectrum of research needs that arise in connection with information requirements for continuing improvement of the process of forest harvest planning. Some of the research needs involve long-term process-related research. Some involve a need to understand specific responses to specific treatments or logging activities. In indicating these needs, this paper is not providing a wish-list. It may provide future direction for selected studies however and it should reveal that one study such as the Carnation Creek project cannot bring in all the answers.

There is a need for long-term research or process-related research in the following areas:

- (1) Steep slope, deep soil, V-shaped valleys. Watershed processes and responses to different logging treatments within them.

- (2) Thermal regimes and the role of basin shape, structure and aspect in determining them. Clear-cutting effects, in different types of basins.
- (3) Hydrological process in coastal streams with rain-on-snow characteristics. Clearcutting effects on the flow regimes.
- (4) Second growth systems and watershed responses in the transition to second growth.
- (5) The biology of salmon populations, representative of different areas with major climatic, and topographic and pedological differences.

There is a need for synoptic work and controlled experimental studies to which to relate the Carnation Creek work.

There are a number of short-term or issue-specific studies that are needed in order to provide managers with a firmer basis upon which to make judgements about the application of planning guidelines and protection clauses. These are listed here:

- (1) Debris and needle movement into fish habitat from streams (intermittent in some cases) to fish bearing streams. The release and movement of gravel and sediment held in the debris in such small, non-fish streams.
- (2) The role of valley topography in capturing sediment released in forest harvest.
- (3) Prediction of debris behavior in tributaries. What determines when a stream will move it, how far it will go, and how rapidly it will move? What is the impact of a series of roads, across a small stream, on water deflection and the related, potential movement of gravel and debris?
- (4) What should be measured for the best pre-logging assessment to be used to deal with these problems?
- (5) Sources of gravel and sand, in different kinds of systems, from fill, banks, road surfaces and mass-wasting.
- (6) Operational sediment monitoring is needed from construction in various kinds of areas. It should look at effects of different percents of cut and fill in different substrates.
- (7) Rates of cutting on rain-on-snow sites as opposed to rates on sites like Carnation Creek. Where wildlife values are considered to be low, industry may want a more rapid cutting program.
- (8) Effects of bridge sizing and design on channel morphology.

- (9) Sediment effects on fish. What is the role of particle size, particle shape, concentration, exposure velocity and size, season and age of fish?
- (10) What is the role of leaf litter relative to primary production in a stream? Can the loss of all or most of the leaf litter be off-set by increased primary productivity?
- (11) Felling to keep trees out of streams and side channels.
- (12) The behavior of old, large woody debris in large systems. e.g. how much debris is there in the Tsitika? How will it respond with forest harvest? Should it be monitored?

DISCUSSION OF GUIDELINE APPLICATION

This discussion is intended only to raise a few questions that might be kept in mind during a discussion of forest harvest planning guidelines and stream protection.

In carrying out the process of planning forest harvest in a watershed, the following problems may affect a group of managers or some within the group:

- (1) They may not understand watershed processes well enough to be able to predict the consequences of making certain choices or applying a particular guideline or protection clause.
- (2) They may lack an adequate inventory of the watershed. e.g. soil conditions, flow patterns of all streams, tributaries and side channels, fish distribution, temperature conditions and features that may affect temperature responses, volume and condition of debris, etc.
- (3) They may understand watershed processes and have enough information about the watershed but be constrained as company and agency representatives by trade-off concerns. e.g. protection conditions are asked for, and some potential impacts are acknowledged but the industry feels that protection measures aren't worth the cost. To what extent are conflicts generated by economic concerns rather than real disagreement about the presence or absence of a potential impact?

Another question that emerges revolves around the matter of information. Many management and operational people are forced to remain almost continually in the firefighting role. How much do they use the scientific literature and findings that are published? How much access to literature does a management person in Queen Charlotte City, Smithers or Campbell River have if they had time to use it? There is justifiable concern about the need for new information. However, how much and how well do we use what is published now? Should there be a major series of

workshops and reading periods each year for field people?

Should new information find its use in forest planning and watershed protection by way of a continuing expansion of planning guidelines and protection clauses which qualifies them differently for a spectrum of different conditions? Or should the approach to management be developed around a planning system in which the general conditions to be obtained are agreed upon case by case in each watershed; and a plan is developed to meet them. In this case the planning guidelines and protection clauses would still be applied but the approach would be developed on the basis of site specific flexible planning rather than the application of many specific and detailed prescriptions. To what extent is there a dichotomy in processes here?

The questions raised in this discussion have been posed because it seems reasonable to believe that the application of forest harvest guidelines is affected by technical considerations, i.e. lack of appropriate information, and planning or behavioral considerations, i.e. constraints on people, and their attitude to the protection process.

Although this paper is prepared to assist in feeding scientific information into the guideline review process it is important that reviewers consider some of the other elements that may limit the rise of sound technical information. Reviewers should also consider the factors that may limit the successful use of the information that is obtained.

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Table 1. Effects of components of the logging process on natural regimes in Carnation Creek and some comments about planning guidelines and protection clauses.

Natural regime	Determined by	Accentuated, increased or changed by	Observations/Impacts	Comments re guideline & P-clause application
Light conditions	Hours of daylight Cloud cover Topography Stream aspect Canopy	Canopy removal at streamside	1. Higher illumination at stream level - A contribution to higher productivity effects potentially positive.	- The challenge for the forest and fisheries manager here is to obtain the positive effects of light increases on the stream and increased primary productivity without the loss of all leaf litter input and without adverse physical changes in channel form and in-stream cover.
Temperature regime	Air temperature direct sun	Streamside cutting Hillside cutting	1. Stream temperatures related to air temperature solar radiation and discharge 2. Clearcut tributaries - summer temperatures up. 3. Main-stem, higher summer temperatures, higher diel temperature range. 4. Winter stream temperature higher after clear-cutting and follows air temperature with time lag. Effects, whether positive or negative, complex and depend on species and flow regimes. 5. Summer temperature changes - effects on growth potentially positive.	- Groundwater storage and temperature plays an important role in determining stream temperatures. Clear-cutting effects on thermal regimes may be different depending on stream discharge and aspect, and upon catchment basin shape and structure. Practices, that may affect winter temperature regimes, and the effect of changing such regimes, should be evaluated carefully.

Table 1 (cont'd)

Natural regime	Determined by	Accentuated, increased or changed by	Observations/Impacts	Comments re guideline & P-clause application
Nutrient regimes	Ions in with rain vegetation decomposition. Soil nutrient release Weathering bedrock.	Soil disturbance - Roads - Yarding - Slash burning - Scarification Change in vegetative structure - Tree removal (Conifers).	1. Most ions strong inverse relationship to flow. 2. Same after logging with higher concentrations. 3. Phosphates low concentration not related to stream flow. 4. Nutrient increase, effects potentially positive. Chemical balance begins to return to pre-logging conditions within years.	
Hydrological regimes	Precipitation - Volume - Timing - Rain-snow ratio Soil conditions Evapotranspiration rates Air temperature, humidity and wind related to snow melt.	Tree removal Soil compaction Road construction Ditching Direction of yarding	1. Rapid slope water transport in porous soils and micro-channels. 2. Valley bottom groundwater higher in areas logged and scarified. 3. Winters - 1976-77 to 1979-80. Fewer and less severe storm events. 4. No clear evidence of change in annual water yield or in storm hydrograph peak flow or time to peak characteristics in the Main Creek.	- Road construction and associated drainage may re-direct volumes of flow critical to small tributaries, e.g., flow routes in H-tributary have been changed. - Higher groundwater levels should be advantageous to fish production in back-channels in the summer low flow period. - In considering these results and interpreting guidelines it should be remembered that these kinds of responses may not occur in watersheds where rain or snow events are common.

Table 1 (cont'd)

Natural regime	Determined by	Accentuated, increased or changed by	Observations/Impacts	Comment re guideline & P-cleanse application
Hydrological regime				
			5. In small clearcut northside tributary annual yield and summer minimum flows are higher.	
Debris conditions	Streamside veg-station - Growth, falldown and movement	Streamside cutting	1. Volume and stability of debris reduced in areas clearcut to bank and cross-stream yarded. 2. Volume and stability of debris high in leave strip areas. 3. Small debris produced in Int. Treat. areas unstable in storms. Negative effect. 4. Large debris armours banks and maintains variable channel form. 5. Reduced cross-section area most of the channel.	- Debris is still moving in the channel and the channel is still changing more rapidly than in pre-logging conditions. - De-stabilised banks, upstreams are considered to be a major source of sand and bedload that affects downstream areas. The changes noted in Carnation Creek suggest a need for close attention to those guidelines that bear on: treatment of vegetation at the stream side, treatment of large stable woody debris in the channel and treatment of the banks themselves. The sensitivity of these elements in a stream depends on the degree of fluctuation of discharge.
			6. Channel location and form still changing in the intensive treatment area (ITA). Changes have taken place in the careful treatment area, upstream from ITA, since the storm Dec. 25-26, 1980 and Jan. 1982.	

Table 1 (cont'd)

Natural regime	Determined by	Accentuated, increased or changed by	Observations/Impacts	Comment re guideline & P-clause application
Sedimentation	Precipitation	Roads	1. Increased sand in top layer of gravel.	- This work may not provide a good basis for assisting in road planning or for interpretation of road construction impacts in soft or erodible materials, because much of the road construction was in rocky material. - Because sand and bedload material appear to be coming from up to 1.5 km upstream and affecting fish survival in lower reaches, this work suggests guideline attention to small feeder streams high in valley slopes. These may release material if not carefully managed.
	Soil type	Cutting	2. Main effect in lower 2 km of Creek.	
	Soil depth	Post-logging treatments	3. Most fine sand and silt is probably flushed completely out.	
	Slope	- Fire	4. Quantities of sediment from different sources, not determined.	
	Meteorological events	- Scarification	However, stream bank erosion is considered to be a primary source.	
		Slope failures		

Table 11. Some effects of changes in Stream Conditions on Fish in three Major Components of the Carnation Creek Watershed A-Main Stem, B-Small Side Channels and Sloughs, C-Estuary (+, - and 0 indicate positive, negative or no clear effect known, respectively).

Production role	Stream temp. change					Streamside vegetation loss	Large debris loss	Channelization	Sediment increase
	Winter increase	Summer increase	Summer increase	Summer increase	Summer increase				
A Adult migration	0	0	0	0	0	0	No effect if debris does not pile up or form a barrier with small debris.	Loss of holding pools.	0
Egg deposition	0	0	0	0	0	0	Loss of cover may affect distribution of adults and hence eggs in the stream system.	Change gravel size composition. If gravel too coarse adults may have to find alternate nest sites.	0
Egg to fry development incubation time decreased	+ Incubation time decreased.	0	0	0	0	Indirect effect of leave strip removal; more streamside soil disturbance and hence potentially more sediment. Effects related to topography.	0 - No direct effect but large debris loss leads to or is associated with bank erosion and sedimentation.	- Scouring and bed-load movement associated with channelization affects egg-to-fry survival.	- Sand deposition increases in upper layer of gravel, this related mostly to bank erosion in "intensive" treatment area and "careful" treatment area above it. Effects on permeability and O ₂ level.
Fry emergence	0	0	0	0	0	See note above and under sediment increase.	0	0	Sediment increase in upper gravel layer reduces ability of fry to move from gravel into the stream.
Fry growth and survival (first summer)	+ or - + for early growth start, - for fry loss in early spring storms.	+ Improved stream production and faster growth.	0	0	0	+ 4 for more light input and increased primary and benthic production possible - effect for less leaf litter input related insect production. Possible - for reduced terr. insect input.	0 - No direct effect but would affect level of summer bird predation.	- Lower fry production in channelized areas of intensive treatment zones after small debris was flushed out (Nov. 1978).	0 or - Sand may affect macro-invertebrate production. Experimental addition of sediment, 0.5 to 2.0 mm caused an increase in the movement of macroinvertebrates and a decrease in their stream bottom densities.

Table II (cont'd)

Production role	Stream temp. change				Channelization	Sediment increase
	Winter increase 2-4°	Summer increase 6-10°	Streamside vegetation loss	Large debris loss		
B Fry growth and survival (first summer)	+ Early growth start. + Faster summer growth if temps. not too high.	- Fish loss due to high temp. and low O ₂ during first one or two years after logging in position of leaf litter input. - Loss of streamside vegetation may enhance predation	+ Primary production and stream insect production, 0. Change in cover for cover in small tribe, where floods are less severe.	0	- Increased temp. with decomposing small debris and organic sediment are considered to have had negative effects on fish production.	
Fry overwintering	+ Larger fry in fall, better overwinter survival (based on mainstem data).	0	0 or - Removal of streamside vegetation may increase predation.	0	0 Negative effects from pool in-filling?	
Yearling growth and survival (2nd summer)	+	-	+ and - See note, "Fry growth and survival (1st summer)".	0	- See note "Fry growth and survival (1st summer)".	
Yearling overwintering	0	0	0 Removal of streamside vegetation and increased light intensity may increase predation effectiveness.	0	0 - Negative effects from pool in-filling?	
C Adult migration	0	0	0	0	0	
Egg incubation (Chum)	0	0	0	0	- Scour and bed-load deposition has occurred over chum spawning sites below the high tide line. - Fine sediment may move through the estuary. Sand settles out in upper intertidal area, and downstream. Influence is not known.	

Table II (cont'd)

Production role	Stream temp. change					Channelization	Sediment increase
	Winter increase 2-4°	Summer increase 6-10°	Streamside vegetation loss	Large debris loss	Channelization		
C Fry growth and survival (late hatch and arrive in estuary earlier than in pre-logging period.)	+	0	0 - Fry in estuary feed on drift, terrest. insects and estuarian benthos. Role of streamside vegetation?	0 - Little debris in estuary, but fry use it with banks and pools for cover.	0	0	0
Fry overwintering, (late fall residence only).	0	0	0	See note above.	Some winter storm scour and fill has occurred in the estuary some of the stream. If it becomes more extensive it will have adverse effects on coho habitat.	0	0

Table III. Planning guidelines and P-l clauses that can be used to prevent or reduce losses in the capacity of the mainstem, small tributaries, side channels, and the estuary of a stream system, to produce fish. Guidelines and P-l clauses are chosen as relevant, primarily on the basis of conditions observed in Carnation Creek. (Guidelines and P-l clauses referred to are given in Appendix IV and I.) Note the planning guidelines and P-l clauses referenced under channelization in side channels and small tributaries are most relevant to the prevention of problems in small steep tributaries.

Type of Habitat in stream system	Change of stream condition associated with forest harvest				
	Increase in stream temp.		Loss of cover		Gravel change
	1-2°-winter	2-4° summer	6-10° summer	Streamside vegetation	
Main stem of stream	A6,B,D	A6,A14,B,D	A6,A14,B,D	A6,A7,B,C,D,E&F,P1-I A2,A3,E,E,F, P-1a,P-1b, P-1d,P-1e, P-1g.	A6,A7,A14,B,D, E,J1,J2,J3,J5, J8,P-1b,P-1d, P-19. A1,A2,A3,A4, A6,A7,A14,B, C,D,E,F,J1, J2,J3,J5,J6, J7,J8,P-1a, P-1b,P-1c, P-1d,P-1e, P-1f,P-1g, P-1h,P-1i,
Side channels, sloughs, and small tributaries.	A6,D	A6,D	A6,D	A6,A7,A14,B, D,E,J1,J2,J3, J5,J8,P-1a, P-1b,P-1d, P-1e,P-1f, P-1g,P-1h.	A2,A3,A7,B,D, E,F,J1,J3,J4, J6,J8,P-1a, P-1b,P-1d, P-1e,P-1f, P-1g,P-1h, P-1i.
Estuary	—	A6,D	A6,D	E,J1,J6,P-1a,P-1c, P-1d	J1,J6,P-1a, P-1b.

**A PRELIMINARY FISHERIES EXAMINATION
OF THE CONTENT, APPLICATION AND
ADMINISTRATION OF THE STREAM
PROTECTION CLAUSES ("p" CLAUSES)
ON VANCOUVER ISLAND**

**M.J. Brownlee, Senior Project Manager
Habitat Management Division
Department of Fisheries and Oceans**

**D.C. Morrison, Regional Habitat Protection Biologist
Ministry of Environment
Regional Operations**

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I Introduction

For the past 10 years the Carnation Creek Study has been looking at pre, during and post logging baseline stream ecosystem relationships with a view to documenting the results of standard and experimental logging practices on a coastal watershed.

As a result of the Carnation Creek workshop held in February 1982, the Ministry of Forests agreed to review the current stream and water quality protection guidelines presently in use in light of the tentative results of the Carnation Creek Study. A Steering Committee and three working groups were established to evaluate the need for such a revision of the present guidelines and administrative procedures.

The Provincial Ministry of Environment and the Department of Fisheries and Oceans have prepared the following submission in response to that request. The concepts and comments presented reflect the position of both headquarters and field staff of these fisheries agencies with respect to streamside logging on Vancouver Island and the adjacent lower mainland.

II Background

In recognition of an apparent need to consider fisheries values during forest harvesting operations, a series of stream protection clauses ("p" clauses) were introduced in the Prince Rupert Forest District in 1956. The clauses (Appendix 1) remained basically unchanged until January 1979 when much of the text was altered (Appendix 2) by the MOF in Victoria to reflect "a more realistic appraisal of actual operations" (personal communication, B. Bishop, ADM - MOF). Prior to 1979, the clauses if interpreted literally, were being violated by almost every operation undertaken near a stream. The changes that were made involved the addition of a general pollution prohibition clause and provision for allowing Forest Officers to authorize without agency consultation, the deposition of a "polluting substance" into water. Successful implementation of the clauses relied (and still relies) on sensible site specific understanding and application by members of the Industry, MOF, F&W and DFO.

III The "p" Clauses

For purposes of discussion and possible revision of specific conditions, a review of the current "p" clauses (Appendix 2) from a fisheries perspective would appear a useful initiative.

Clause interpretation and fisheries comments are in bold print.

8.00 Field Practices and Water Resources

8.01 In respect of timber harvesting and related operations carried out on the permit area the licensee will:

- a) not permit a lake, stream or spring that supplies water for any purpose, to be rendered unfit for that purpose, or

This is an all-encompassing general pollution abatement provision unless otherwise authorized by a Forest Officer. "To be rendered unfit" needs clarification from a fisheries perspective.

- b) not permit trees, logs, logging debris or any polluting substance to be deposited into a lake, stream, or spring, unless authorized by a Forest Officer, or

This provision focuses on logging debris, which over the years has been observed to have serious consequences on the stability of stream channels and instream "structures" (log jams etc.)

- c) not permit logs to be skidded or equipment to be operated below the high water mark of a lake or stream, unless authorized by a Forest Officer, or

This provision is concerned with the actual operation of equipment and skidding of logs not only in the wetted perimeter but also below the high water mark of a water body.

- d) not permit any obstruction, gravel or fill to be placed below the high water mark of a lake or stream, unless authorized by a Forest Officer, or

This provision focuses on road (bridge and culvert) construction activities. The minimum road specifications for the Vancouver Region (Appendix 3) require design criteria of 100 yr, 50 yr, and 25 yr storm frequencies depending on the watercourse. Fisheries agencies often prefer the use of wood (cedar) culverts in place of metal ones as each crossing may then be "custom fitted".

- e) not permit a landing to be located within 40m of a lake or stream or in an area that is not designated for harvesting in this Cutting Permit, unless authorized by a Forest Officer, or

In general, landings should not to be located within 40 m of a lake or stream. Landings are of particular concern because they are sites that may have required major cuts and fills, and are areas of intensive equipment operation, debris generation and

exposed soils all of which have the potential to greatly impact on water bodies. Putting landings "to bed" on cessation of operations is not considered in this provision.

- f) not permit slash to be burned closer to a lake or stream than the distance specified by a Forest Officer.

This clause provides for the protection of riparian zones by preventing slash burning adjacent to lakes or streams.

8.02. In respect of further harvesting and related operations carried on under this Cutting Permit the licensee will:

- a. remove logging, milling and roadbuilding debris deposited in and on the banks of lakes and streams,

Logging, milling and roadbuilding debris should be removed if deposited in or adjacent to lakes and streams that are occupied by fish or have fish potential. Similarly, debris should be removed from watercourses that have the potential to transport material downstream to fish bearing waters.

- b. direct falling and yarding of timber away from lakes and streams and their banks,

Directional falling of timber away from streams or lakes is recommended to prevent sedimentation, damage to the riparian zone, or prevent introduction of debris to the stream. Special falling techniques (jacking away, cable assist etc.) are developing in this area although most recent DFO/P&W recommendations relate to the leaving of leaners next to watercourses as these will provide instream stable macro debris when they eventually fall.

- c. protect natural growth in and on the banks of lakes and streams from damage from logging and burning,

This clause provides for maintenance, protection and replacement of natural riparian vegetation although "natural growth" is not well defined. Fisheries agencies recommend that all deciduous and immature coniferous growth be maintained through all silvicultural phases. (See Appendix 6, letter to D. Grant dated June 4, 1982)

- d. build a bridge or install a culvert at every stream crossing, designed to accommodate the maximum flow of the stream and to permit unobstructed fish passage, and

All waterways should be appropriately culverted, although maximum stream flow and fish passage conditions (see "Dane") are not well defined. Maximum stream flow may be determined by vegetation or water scour marks.

- e. schedule the construction of stream crossings as directed by a Forest Officer.

The Industry should determine whether restrictions are necessary, and appropriately schedule stream crossing activities. Preferred fisheries agency timing for instream work in sensitive areas is usually the low summer flow period (July, August).

Discussion

With respect to the aforementioned conditions, clauses 8.01(b) and 8.02(b), (c) and (d) are the ones that have resulted in the most difficulty in terms of interpretation and application in the field. Clauses (b) and (c) of 8.02 together with a 1974 MOF directive (Appendix 5) are the conditions that form the basis of the "p" clause logging treatments adjacent to streams. The actual field interpretation and application of these conditions are discussed later in this paper. Areas of major difficulty with these clauses appear to be:

8.01(b) trees, logs, logging debris or any polluting substance "not" to be deposited into a lake, stream, or spring, unless authorized by a Forest Officer

This clause is an all-encompassing pollution prohibition with inherent difficulties of just how best to achieve it. There are problems with debris and stream definition. Sediment introduction will likely occur, but there is no guidance as to acceptable quantities. This should perhaps be viewed as a goal with exceptions only as approved by the Forest Officer in consultation with DFO/F&W staff.

8.02(b) direct falling and yarding of timber away from lakes and streams and their banks

The definition of a stream is not offered so there are concerns over the additional falling and yarding costs in certain instances (1st and 2nd order streams and gullies - Note: a first order stream is defined as a non-branching headwater segment). Difficulties are encountered by fisheries staff in applying these measures in the upper landscape as impacts of activities either onsite or downstream are not always apparent, demonstrable or quantifiable.

Preliminary Carnation results have flagged the importance of avoiding the introduction of mobile debris into a watercourse as well as the need for a living root network adjacent to this particular type of stream to minimize streambank erosion. Mobile debris should be kept out of fish bearing streams or those

with the potential to transport this material. This is not only for purposes of channel stability but also because of concern over the cumulative nature of these impacts on stream ecosystems. Any debris inadvertently deposited in these watercourses should be cleaned out to the satisfaction of the Forest Officer in consultation with F&W/DFO staff.

(c) protect natural growth in and on the banks of lakes and streams from damage from logging and burning

The definition of natural growth (merchantable?) or "streams" is not offered; nor are leave strip requirements. Also, criteria for wind firmness have not been outlined. Fisheries staff are also very concerned about the loss of certain deciduous species (alder) along fish-bearing watercourses during certain silvicultural treatments. (See Appendix 6)

IV. "p" Clause Application

As one might anticipate in a province as varied and diverse as British Columbia, and considering the decentralized nature of decision-making, the actual interpretation and application of the "p" clauses in the field are highly variable. Streamside treatments range from the retention of varying widths of inviolate leave strips to falling and yarding across streams. Many variations on the theme take place as well (ie. fall away and yard away etc). Factors that are taken into consideration by DFO and F&W staff in formulating their requests include: sensitivity of site to falling or yarding damage, spawning or rearing values, blowdown potential, proximity to fish presence, potential for downstream movement of sediment and/or debris, accessibility of site for cleanup, and company performance and willingness to cooperate.

Given these factors and those variables associated with industrial capabilities (equipment and operators) and other human factors, and in the absence of an all-encompassing document that prescribes in detail "p" clause applications, it is no wonder that a universal "p" clause logging treatment is not readily described (Appendix 5). However, that is not to say that this "state-of-the-art" is not unreasonable given the site specific nature and value of current decision making. The Forest Service booklet "Streamside Management, A Decision-Making Procedure for South Coastal British Columbia" provides the most site specific guidance that can be offered at this time for the varied conditions on Vancouver Island.

Observations and feedback from field staff indicate that serious problems exist in areas where many small streams occur in a given cutblock, particularly in the upper landscape or on floodplains

where fish are present, and these watercourses are not identified on a map nor "p" clause treated but rather just "ignored" through falling and yarding phases. Fisheries agency concerns for small watercourses relate to both those that are fish bearing because of the direct impact on fish habitat, and those that are non-fish bearing on steep upper landscape areas. These latter watercourses are of concern as they are abundant and frequently have the capability to transport sediment and/or debris to the fish bearing reaches of the stream. Operations conducted adjacent to such watercourses should be carried out in a manner that does not generate sediment by disturbing the streambed or streambank and does not destabilize the natural debris in the channel. Channel stability is a major factor contributing to sustained fish production.

Fisheries agencies prefer to use logging guidelines that are presented as prescriptions, defining the method of operation rather than offering permissible standards for sediment or debris additions. This concern arises from the inability to predict quantities that may be generated or to define standards which would avoid detrimental impacts on fish habitat or fish populations. Also, in areas such as Oregon where the concept of standards has been applied, they have been most unsuccessful, (G. Brown, personal communication). Instead, they serve to guide operations by providing suggestions in the form of specific prescriptions.

Field experience would also seem to indicate that problems exist with the lack of familiarity of industrial field staff (particularly fallers, rigging crews) with the content and intent of the "p" clauses. Similarly difficulties are experienced in the field application of prescriptions associated with road design, construction and maintenance. Education of agency and industrial staff would seem most appropriate.

V "p" Clause Administration

As mentioned earlier these clauses are an integral part of the Cutting Permit document that "licenses" forest harvesting and associated activities on both Crown and private lands within TFL's. Applications for permits and/or five year plans submitted by the Industry to the MOF are referred concurrently to F&W/DFO district offices for comment prior to approval by the MOF. F&W/DFO comments are usually requested within 30 days of mailing and permits may authorize everything from activities on a specific cutblock or particular section of road, to 2 or 3 years of total operations in the case of T.S.H.L.'s or T.F.L.'s.

F&W/DFO difficulties with respect to the administration of the permits include: limited lead and review time, insufficient fisheries inventory, lack of biophysical information on the

permit and coordination of on-sites. Because of these difficulties, heavy reliance is made by DFO and F&W staff on the application of "p" clauses, minimum road specifications (Appendix 3) and general logging guidelines (Appendix 4) to protect streams and watercourses either identified on logging plan maps or encountered in the field. Site specific visits while most desirable are arranged for resolution of only a relatively few anticipated problems that have been identified by the field staff of either Industry, MOF, F&W or DFO. Resource limitations (not enough time, people or money) are the major constraints on this level of review although all agree that joint site inspections are the most effective means of resolving difficulties. An important footnote to this process is that there is almost no or at best a very limited followup to determine the effectiveness of the site specific recommendations. While not often formally acknowledged, those pertinent sections of the Fisheries Act (Sections 31, 33) are not rigidly applied by DFO and F&W to engender a spirit of cooperation in this referral process. Charges under the Act are reserved for only those more extreme or flagrant violations and are not usually laid if Industry has demonstrated a cooperative attitude.

VI Stream Definition

What is a stream? In the last few years this question has been asked more and more frequently. Most forest harvesting operations are now being undertaken in the higher elevation areas where the density of gullies, 1st and 2nd order streams becomes much higher, and these features are not always apparent until harvesting operations have commenced. Frequently, fish are often not evident or present and there are questions about the actual impacts of operations at the site or on downstream areas. Thus, the question of stream definition or importance is understandably asked.

The definition of a stream most often applied by Fisheries personnel is "A watercourse (continuous or intermittent) that exhibits a defined channel." In the instance of the Tsitika Plan concern about downstream impacts led to an expansion of this definition to include wet gullies which were defined as gullies "having defined channels" which reflect hydraulic processes potentially sufficient to transport sediment or debris to fish-bearing waters. Also, a more detailed set of prescriptions has been prepared for the Tsitika Followup Committee that describe logging adjacent to small non-anadromous fish streams (Appendix 7). Field testing of these prescriptions is planned.

In reviewing this particular aspect, the problem does not appear to be necessarily with the definition of a stream but rather how stringent the recommendations will be that may be forthcoming

where fish are present, and these watercourses are not identified on a map nor "p" clause treated but rather just "ignored" through falling and yarding phases. Fisheries agency concerns for small watercourses relate to both those that are fish bearing because of the direct impact on fish habitat, and those that are non-fish bearing on steep upper landscape areas. These latter watercourses are of concern as they are abundant and frequently have the capability to transport sediment and/or debris to the fish bearing reaches of the stream. Operations conducted adjacent to such watercourses should be carried out in a manner that does not generate sediment by disturbing the streambed or streambank and does not destabilize the natural debris in the channel. Channel stability is a major factor contributing to sustained fish production.

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In reviewing this particular aspect, the problem does not appear to be necessarily with the definition of a stream but rather how stringent the recommendations will be that may be forthcoming

from F&W/DFO staff. Upstream of anadromous and resident fish populations, fisheries agency concerns are principally with sediment and debris transport to fish-bearing waters. In the absence of concrete impact data and given the difficulty in predicting cause/effect relationships considering such variables as stream gradient, catchment area, distance upstream of fish presence and potential debris torrents, DFO/F&W staff are understandably cautious. Field disagreements may centre on falling direction, yarding techniques and direction, cleanup requirements and if so required, how much will be necessary? Owing to the inherent nature of the problem (complex variables of distance and time) these cause/effect relationships are most difficult to determine. Both short and long term studies will be necessary to better understand them.

VII. Recommendations

1. A detailed technical followup by an appropriate group of Industry and Agency Staff be undertaken to determine:
 - a) specific "p" clause effectiveness and further problem identification
 - b) current interpretation and application of "p" clause logging being undertaken by the different licensees in each of the biogeoclimatic zones on Vancouver Island initially and, if appropriate, all of B.C.
2. The following aspects of administration of the "p" clauses be explored more fully (possibly by the group identified in 1.) and recommendations offered where deemed necessary regarding:
 - a) the adequacy of the current level of information provided with the Cutting Permit document and five year plans (ie. contours, watercourses, soil types, precipitation, specific problems)
 - b) the current lack of biophysical reconnaissance data
 - c) adequacy of lead time (30 days) for evaluation of C.P. and five year plan information in view of (a) and (b) above
 - d) current MOF efforts in supervising "p" clauses
 - e) potential solutions to the problem of lack of resources for onsite inspections (ie. Industry use of field inventory cards for streamside prescriptions prior to Agency referral which are then forwarded with the permit application.)

- f) followup efforts on cutblocks be undertaken by respective field staff to determine guideline effectiveness. Perhaps a formal review by Agency and Industry staff 30 days after completion of falling and yarding.
3. The definition of streams and gullies and their treatment in the field be assessed to determine if these areas are being adequately protected.
 4. The term "natural vegetation" contained in the "p" clauses be defined.
 5. Those provisions of the "p" clauses that allow the Forest Officer to authorize instream activities should be changed to authorization only on consultation with DFO/F&W staff.
 6. Where "p" clause infractions are noted and/or persist, penalties should be clearly spelled out and imposed. Mitigative measures should be implemented immediately.
 7. A detailed technical examination should be made of: the Planning Guidelines for Coastal Operations; the Engineering Specifications for the Planning, Design, Location, Construction and Maintenance of Logging Roads and Drainage Structures in the Vancouver Forest Region; and the 1974 MOF Streamside Directive (Pogue's Circular). A preliminary F&W comment on these three documents is attached as Appendix 6.

References Cited

- Dane, B.D. 1978. Culvert Guidelines: recommendations for the design and installation of culverts in British Columbia to avoid conflict with anadromous fish. Fisheries and Marine Service Tech. Rep. No. 811. 57 p.
- Moore, M.K. 1980. A decision making procedure for streamside management on Vancouver Island. A booklet for operational testing and use. Research Division, Ministry of Forests, Victoria. 43 p.
- Tsitika Planning Committee. 1978. Tsitika Watershed Integrated Resource Plan. Summary report, Vol. II. 52 pg., plus appendices.

Appendices

- Appendix I - Stream Protection Clauses
- Appendix II - Stream Protection Clauses (Revised)
- Appendix III- Engineering Specifications for the Planning, Design, Location, Construction and Maintenance of Logging Roads and Drainage Structures in the Vancouver Forest Region
- Appendix IV - Planning Guidelines for Coast Logging Operations
- Appendix V - A Prescription for Streamside Logging in the Vancouver Forest Region (M. Pogue's 1974 Circular)
- Appendix VI - Ministry of Environment (Fish and Wildlife) Preliminary Comments on Ministry of Forest's Guidelines
- Appendix VII - Fisheries Prescription Guidelines for Non-anadromous Streams in the Tsitika Watershed



APPENDIX 1

Stream Protection Clauses.

- P-1 The Licensee shall:
- (a) Not allow any trees, logs, logging debris, or any substance likely to cause pollution to be deposited at any time within any lake or stream.
 - (b) Not allow any logs to be skidded, equipment to be operated, gravel to be displaced, or any damage to be done within the highwater level of any stream channel.
 - (c) Provide all stream crossings with a bridge or culvert the design of which will accommodate maximum stream flow and permit unobstructed fish passage and schedule the construction of all stream crossings as directed by the Forest Officer.
 - (d) Not place or cause to be placed any obstruction or fill within the highwater level of any stream channel.
 - (e) Remove any logging, milling, road building or other debris deposited or caused to be deposited in any stream channel or lake as directed by the Forest Officer.
 - (f) Locate landings no closer than forty (40) metres from any stream channel and only within area designated for cutting.
 - (g) Direct the falling and yarding of trees away from streambanks and lakeshores except as otherwise designated on the ground and approved by the Forest Officer.
 - (h) Not burn slash closer to the streambanks or lakeshores than the distance specified by the Forest Officer.
 - (i) Protect from logging and burning damage all streambank and lakeshore shrubs.
- P-2 Prior to the commencement of operations on any logging area approved for cutting, the licensee shall establish the cutting boundaries on the ground by blazed, or paint-marked lines, or as directed by the Regional Manager and on the approval in writing of the said lines by the Forest Officer the licensee may then commence logging operations.
- P-3 Heritage sites are located on the lands described in this Licence and are subject to the provisions of the historic conservation act. The Licensee, his servants, agents, or workmen causing damage to these sites shall be guilty of an offence under the historic conservation act and shall be liable to the penalties provided therein. In addition, such violation may render this licence liable to suspension and cancellation.
- P-4 This Licence lies within the Watershed Reserve, and the Licensee shall observe all laws and regulations which may be made by the lieutenant-governor in council respecting sanitation.

APPENDIX II

P.1 CLAUSES

(B.C. Ministry of Forests)

Forest Management - Protection Of Other Uses And Reservations

Protection Of Streams, Streambeds, And Lakes (p clauses)

These are the 'p' clauses within the Cutting Permit Documents that were revised in January, 1979. This revision allows the Forest Officer to authorize activities that would contravene these clauses. In view of the Fisheries responsibilities and need to avoid possible conflict, discussions with the Assistant Deputy Minister, Ministry of Forests, have resulted in an agreement whereby a statement of policy will be directed to all Forest Officers *that authorization of these activities will only be on consultation with Fishery Officers and Conservation Officers.*

8.00 Field Practices and Water Resources

8.01 In respect of timber harvesting and related operations carried out on the permit area the Licensee will not permit:

- (a) a lake, stream or spring that supplies water for any purpose, to be rendered unfit for that purpose, or
- (b) trees, logs, logging debris or any polluting substance to be deposited into a lake, stream, or spring, unless authorized by a Forest Officer, or
- (c) logs to be skidded or equipment to be operated below the high-water mark of a lake or stream, unless authorized by a Forest Officer, or
- (d) any obstruction, gravel or fill to be placed below the high-water mark of a lake or stream, unless authorized by a Forest Officer, or
- (e) a landing to be located within 40m of a lake or stream or in an area that is not designated for harvesting in this Cutting Permit, unless authorized by a Forest Officer, or
- (f) slash to be burned closer to a lake or stream than the distance specified by a Forest Officer.

8.02 In respect of timber harvesting and related operations carried on under this Cutting Permit the Licensee will:

- (a) remove logging, milling and roadbuilding debris deposited in and on the banks of lakes and streams,
- (b) direct falling and yarding of timber away from lakes and streams and their banks,
- (c) protect natural growth in and on the banks of lakes and streams from damage from logging and burning,
- (d) build a bridge or install a culvert at every stream crossing, designed to accommodate the maximum flow of the stream and to permit unobstructed fish passage, and
- (e) schedule the construction of stream crossings as directed by a Forest Officer.



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APPENDIX III

File _____
Date _____
Roadway Width _____

BRITISH COLUMBIA FOREST SERVICE

ENGINEERING SPECIFICATIONS FOR THE PLANNING, DESIGN, LOCATION,
CONSTRUCTION AND MAINTENANCE OF LOGGING ROADS AND DRAINAGE
STRUCTURES IN THE VANCOUVER FOREST REGION

A. Engineering Policy

- A1. With due consideration for the appearance of forest landscapes in visually sensitive areas and for the protection of water quality, fisheries, and other resource values, the location and design (alignments and gradients) of all logging roads and bridges shall be such that the combined costs of construction, maintenance and log hauling are minimized. Competent personnel shall be employed for the design and location of roads (and logging layout) and firm supervision and control given all construction work.

When construction is finished the road surface shall be maintained for economical hauling, ditches and culverts for efficient drainage and bridges for safe carrying capacity. Brush shall be removed from the right-of-way as required for good visibility.

- A2. Road construction is recognized as a major cause of stream sedimentation. Accordingly, the amount of road built shall be minimized (in conjunction with logging layout) particularly where unstable or sensitive areas and fine textured soils have been identified. Road construction shall be avoided through areas having a high potential for sedimentation or slope instability wherever other resources are threatened.

Where possible, environmental impacts will be minimized by:

1. locating roads away from streams, narrow canyons, slide areas and marshes;
2. locating roads on benches, ridge tops, and flatter slopes;
3. taking precautions to ensure that non culverted drainage channels are clear and the risk of subgrade erosion is minimized whenever unfinished road is to be left over the winter;
4. prescribing for each road those design specifications that are best adapted to given slopes, topography and soils.

- A3. The following specifications may be modified or amended only with the approval of the Forest Officer. Construction prescriptions, e.g. end hauling, may be added to meet unusual or special conditions.

B. Minimum Road Specifications

- B1. Turnouts: Five turnouts, preferably intervisible, with a useable length of about 30 metres and a total width including road of 8 metres should be built per kilometre of single lane road. For temporary roads, construct turnouts as required and where the least environmental damage will occur.
- B2. Widening: Widen all curves to allow for side tracking of truck-trailer units. On blind curves the road should be at least 8 metres wide around the curve and for 100 metres approaching each end of the curve.
- B3. R/W Clearing, Grubbing, & Slash Disposal:
1. Fell all trees within a R/W area 3 metres beyond the top of cuts and 3 metres beyond the toe of fills.
Fell leaners and damaged trees which are adjacent to the R/W and yard into the R/W any trees felled into standing timber.
 2. Recover merchantable logs.
 3. Remove stumps and organic soil to a maximum width of 12 metres on level ground and easy slopes except where construction by over-landing is being done. Go to widths more than 12 metres as dictated by side-slopes and centreline cuts.
 4. Dispose of road clearing slash and non merchantable wood by piling and burning or by burying either in the toe of the fill, or in push-outs adjacent to the right-of-way as directed by the Forest Officer.



- B4. **Ballasting and Surfacing:** Place sufficient ballast or surfacing material to carry loaded (design load) logging trucks without rutting or deforming the road surface. Give due consideration to the planned traffic frequency, quality of ballast and surfacing materials, and required maintenance.

C. Pits and Quarries

Obtain approval of the Forest Officer for pits or quarries that will extend beyond the right-of-way boundaries. Clear the area and dispose of slash as per B3 sections 1, 2 and 4. Dress the pit slopes to a natural angle of repose before it is abandoned if deemed necessary by the Forest Officer.

D. Bridges

- D1. Locate, design and construct bridges which will:

1. Carry the design load according to accepted Engineering principles.
2. Pass the 100 years flood when materials are glulam, concrete or steel or for log bridges specified by the Forest Officer.
3. Pass the 50 year flood for log bridges over major tributaries.
4. For all other tributaries pass the 25 year flood.
5. Satisfy site specific constraints to limit scour, siltation, erosion and environmental damage.
6. Satisfy timing constraints for construction.

E. Culverts

- E1. Design all culverts according to accepted Engineering principles to carry the design load and pass the specified peak flood. Install metal culverts according to manufacturer's recommendations.
- E2. Select metal pipe or cedar log culverts with enough capacity to pass the 50 year flood on main roads and the 25 year flood on the other roads at $HW/D=1.0$. Place pipe culverts at a slope coincident with the stream slope whenever practical.
- E3. Install enough culverts to ensure the natural drainage pattern of all streams both seasonal and continuous. Install additional culverts as necessary to drain ditches and minimize ditch erosion. Provide temporary culverts during the pioneering stage where siltation or erosion is a problem. Keep stream channel free of construction debris.
- E4. Space crossdrain culverts no more than 150 metres apart on grades over 10% and 230 metres on grades less than 10%.
- E5. Do not install metal culverts smaller than 450 millimetres in diameter or wood culverts with an opening smaller than 500 millimetres by 1000 millimetres.
- E6. Select sound cedar for wood culverts. As a general rule, place sill logs outside the average high water mark of the stream unless otherwise designed as per E1.
- E7. Provide adequate drainage at all road junctions.
- E8. Adopt, as part of the regular maintenance program the inspection and maintenance of ditches and culverts.
- E9. Inspect and if necessary, clean out and repair all ditches and culverts before the normal runoff season and immediately following peak or exceptionally heavy rainfalls.
- F. Special Provisions for the Maintenance of Water Quality
- F1. Install aprons or flumes to carry water from culverts over unstable fills or preferably, replace the unstable fill at the culvert with a non erodible material (e.g. rip-rap) to absorb the impact of discharge. Protect culvert inlets from erosion as required.

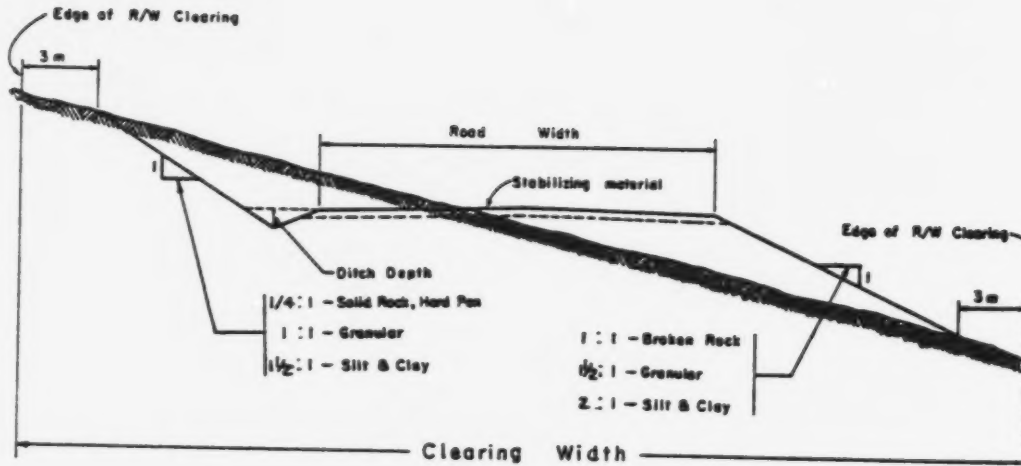
- F2. Maintain the natural course of all streams whether seasonal or continuous.
- F3. Install crossdrain culverts to divert ditch water away from seasonal and continuous streams, or direct the water into sediment catchment basins away from the streams.
- F4. Construct cut and fill slopes to suit the local soil and rock material. See Form F.S. 650 for some recommended slopes.
- F5. Adopt measures to stabilize cutbanks and fillslopes when soils are unstable, e.g. grass seeding.
- F6. Plan borrow pits and waste areas to minimize erosion and water turbidity.
- F7. Do not dump or spill material or debris in any stream or lake. Keep culvert and bridge sites clean during and after construction.
- F8. Suspend any road building operation causing erosion or siltation especially during periods of intensive rainfall or heavy runoff or when soils are saturated.
- F9. For shovel constructed subgrade on easy slopes, increase the cleared width to provide for spreading of unuseable material. Such material should be spread no more than 1 metre deep and must be suitably protected to prevent erosion, (e.g. grass seeding).
- F10. When forest operations on temporary roads are finished, (or annually if necessary) remove all culverts and temporary bridges and construct water bars.
- F11. Use backhoes to build road on erodible or poorly drained soils.
- F12. Maintain the road to prevent accelerated erosion and water quality degradation. Crown roads to prevent the accumulation of surface water.

G. Special Provisions for Protection of Fish Bearing Streams

- G1. Obtain the approval of the Forest Officer for the design, and the time and method of construction of all structures proposed over fish bearing streams.
- G2. Protect the shorelines of streams and lakes and shoreline shrubs from damage due to right-of-way clearing, logging and burning as specified by the Forest Officer.
- G3. Observe all constraints listed above particularly in D, E and F.



ROADWAY CROSS SECTION



ROADWAY DIMENSIONS IN METRES (m)

ROAD WIDTH	DITCH DEPTH	CLEARING WIDTH
4 - 6	0.3	20
7 - 8	0.5	20
9 - 10	0.7	25
11 - 12	1.0	30

Local variations in the standard road dimensions are frequently required because of the following circumstances:

- Clearing width - steep side slopes usually require wider clearing to provide the necessary 3 m of cleared width above cut banks or to contain the fill.
- Subgrade width - may be increased for turnouts and widenings or decreased in rock cuts.
- Ditch depth - may be increased to facilitate adequate ditch gradients, or for drainage of unusually wet soil. Depth may be decreased in rock sections. In flat country, scraper ditches approximately 4 m wide may be constructed to obtain material for raising the subgrade above the general ground level.

APPENDIX IV



FOREST SERVICE
VICTORIA, BRITISH COLUMBIA

September 29, 1972.

PLANNING GUIDELINES FOR COAST LOGGING OPERATIONS

A. The general practice shall be to clear-cut to the close utilization standards, with the objective of creating even-aged stands on the sites harvested. Logging must be conducted in such a manner that fire hazard is reduced to an acceptable standard and the cutting area is satisfactorily prepared for the future crop. In addition to cutting all species to a minimum diameter limit, felling of all trees ten feet and over in height, regardless of merchantability will normally be required.

Of great concern is the matter of protection of water quality and the maintenance of a managed environment suitable for the preservation, protection, and regulation of other users of the forest habitat. Measures must be taken to ensure that all protective forest cover is not removed, but rather that sufficient trees or blocks of forest are left to meet the necessary requirements of the other users. Protective cover requirements will vary with wildlife species present and their habitat requirements, size of stream, type of bed, water-flow continuity, the present or potential value for fish and game, human consumption, and recreational use. Wildlife and fish habitats of significance must receive special consideration. Normally, many different types of forest cover will be present over the greater percentage of any managed unit and they must be recognized and deliberately incorporated into area plans. These include:

- (1) inaccessible trees which occur in steep rocky canyons and on steep bluffs;
- (2) tree growth occurring on unstable, erodible cutbanks;
- (3) leaning trees along water-courses and shorelines which cannot be removed without causing environmental damage;
- (4) fast-growing deciduous trees of suitable species, not subject to extra-site encroachment, planted along water-courses or shorelines either prior to logging or after slash burning;
- (5) primary timbered leave strips for fire control and their replacements;

- (6) leave blocks which will not be cut until adjacent blocks are reforested to the stage required to assure compatible integrated use;
- (7) filter strips between roads or openings and waterfront or stream banks, held temporarily pending stabilization of run-off within the developed area;
- (8) pre-established second-growth timber or satisfactorily renewed immature stands resulting from earlier cutting or from other causes such as fires, and not forming part of present cutting areas;
- (9) forest cover in parks or other ownerships not being cut over;
- (10) needed wildlife corridor patches held pending re-positioning into renewed forests or alternative areas;
- (11) forest recreational use development areas;
- (12) forest utilized as "surround" for unique features;
- (13) forest temporarily held in pocket or strip for recreation areas, pending development and eventual re-positioning into alternative areas;
- (14) forest temporarily held on alternate "50 percent" cut program for watershed protection, held pending development of new forest on adjacent cut-over areas to the stage required to assure compatible integrated use.
- (15) stream-face or shoreline blocks subject to special treatment, stand improvement, or special cutting system.

Forest land within a watershed will be harvested under the multiple use concept. Consistent with the incorporation of forest recreation, game habitat, and watershed management into cutting plans designed to accommodate these and other resource uses, mature timber, extending to stream borders, may be harvested using such special measures as deemed necessary. These measures will prevent stand decadence and ensure the renewal of forest growth along water courses within a time sequence logical to a managed forest environment. Only in this way can quality stream maintenance, as well as the needs of people, be provided for simultaneously. Examples of using special measures where necessary may include: approved forms of selective cutting,

cutting narrow strips or smaller patches, mechanical or other powered methods of controlling the direction of tree fall, felling of trees from opposite banks and lifting clear to avoid environmental damage, etc. Such measures will often involve precise timing of critical operations, such as road and bridge development, stream clearing or improvement and other forestry operations that can best be done at certain times of the year, depending on the circumstances within the particular managed unit.

B. The size, shape and orientation of clear-cut openings shall be based on an analysis of forest regeneration, logging economics, fire protection, fish and wildlife production, soil protection, aesthetic appeal, water quality maintenance, etc. In other words, utilization of all resources and compatible integrated use shall dictate the size, shape, and orientation of each individual proposed opening. Normally, the openings should be kept as small as practicable and, as a basic guideline, the size of a clear-cut opening will not exceed 200 acres unless the aforementioned factors dictate otherwise.

C. Logging in deferred areas, adjacent to the initial clear-cut openings, will be considered when hazard has been abated and restocking requirements are met within the first opening and the maintenance of other resource values is assured.

D. Clear-cutting will be based on an alternate system of cut and leave patches. The location of the patches must be adjusted to meet the needs of other integrated uses. Also, an alternate patch system is required to reduce the potential for increased water temperature, sediment, and logging wastes that could reach perennial streams or lakes. The percentage of the total stream face or lake to be opened during any one phase of patch-logging will depend on the sensitivity of the particular area to logging disturbances. As a guide, no more than 50 percent of a stream or lake face will be opened during one phase. At no time during the same phase will two cut openings be permitted to face each other across a perennial stream unless the maintenance of other resource values has been assured.

E. All logging adjacent to streams, stream-beds, and lakes must be regulated so as to ensure there is no violation of stream protection requirements. Setting boundaries and yarding plans shall coincide with water-courses so that there is no yarding damage. The protection of water quality will normally require care and special measures in falling, bucking, and yarding away from the stream or lake, and cutting will not commence until the boundaries have been approved.

F. Cutting within approved openings adjacent to streams or lakes when required will be regulated so that a filter-strip adjacent to the stream or lake will be reserved until the last logging sequence within the opening. To effect good stream-bank clean-up, care and special measures will be taken in falling, bucking, and yarding away from the stream or lake.

G. Stands which would be uneconomic to treat will be excluded from within approved cutting boundaries unless their inclusion is necessary to the creation of the proper size, shape, and orientation of the treated site in its finished form. Similarly, certain stands or portions of stands which could be economically treated, but whose exclusion is required by the proposed pattern of cutting, will be excluded from the approved cutting boundaries.

H. Approval for further cutting in untouched stands will only be given where acceptable logging plans and utilization standards pertain to the timber in question and to any adjacent stands of lower value which should be logged. Rehabilitation planning for older partially logged or poorly stocked old growth forest must be co-ordinated with the plans for logging the adjoining standing green timber or it will be necessary for the proposed new cutting to be deferred to some future date.

I. All satisfactorily-stocked immature forests of manageable proportions surrounding or adjacent to mature merchantable timber will be reserved and protected.

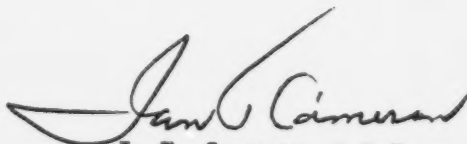
J. All roads, (main roads, secondary roads, spur roads, and skid trails) must be planned, located, designed, constructed, used and maintained in such a manner that their impact on the total managed unit will be an acceptable minimum by:-

- (1) locating roads away from streams, narrow canyons, slide areas, and marshes;
- (2) locating roads on benches, ridge tops, and flatter slopes to minimize harmful disturbances and improve road stability;
- (3) prescribing for each road those design specifications that are best adapted to given slopes, topography, and soil materials;
- (4) disposing of the slash and debris concurrently with construction;

- (5) building culverts large enough to handle a 25-year frequency storm. Aprons or troughs should be installed where needed to carry runoff water over unstable fills to the undisturbed soil below the culvert;
- (6) minimizing soil disturbance in road construction by working only while soil moisture conditions are favourable (i.e. not too wet)
- (7) adopting regular maintenance programs which should include inspection and clearing of ditches and culverts as well as grading of roads;
- (8) constructing cross drains and water bars on skid trails, spur roads, and secondary roads to control and direct runoff which collects at the road, particularly away from creeks;
- (9) revegetating cutbanks and fill slopes where necessary in some areas to prevent erosion.

K. Operating plans and proposals are subject to approval prior to implementation and the Forest Service will consult with other resource managers to ensure that their input will assist in attaining the basic objective of maintaining an environment satisfactory and suitable to the needs of all British Columbians.

L. These guidelines are considered to be an essential facet to an effective base for planning, resource allocation and management of operations and constitute the minimum requirements for forward planning. However, they must not be construed as being absolute. Particular forest units, special circumstances, or needed objectives and policies will also dictate the resultant planning and treatment required for development and cutting plans.


I. T. Cameron, R.P.F.
Chief Forester.

APPENDIX V

Vancouver V6C 2H1, B.C.
July 9, 1974
File: O. Protection Sup.

TO: ALL RANGERS AND OTHER FIELD OFFICERS

Vancouver District Circular Letter VR 74-245
Re: Administration of "P" Clauses

You have recently received Management Manual Amendment No. 77 in which Clause P-1 has been revised. This clause now appears in the printed portion of most contracts. You will note that the new wording no longer prescribes one chain (or the distance as laid out) to establish a stream and/or lakeshore protective strip from logging and burning damage.

In view of the new wording of Clause P-1 it is now our intention to control and police possible streambank and lakeshore damage through the use of the boundary approval Clause P-2. Therefore, a standard boundary approval letter has been drawn up in which a statement regarding streambank protection has been included. This form is attached and is to be used immediately by all Ranger Districts.

We have also prepared the attached statement to be brought to the attention of all licensees and operators. This is to be given as wide a circulation as possible to emphasize to industry our intent to "police" this clause more closely. Any opportunity to discuss and re-iterate this policy as outlined should increase the "Industry's" understanding of our administrative objective in safe-guarding fish and game habitat and water quality in all streams, stream-beds, and lakeshore areas. At the same time, we must remain cognizant of our responsibility to harvest the merchantable volumes contained on forest lands within our jurisdiction.

There is some jurisdictional change in the administrative aspect of these clauses. Henceforth, the "post award" phase of stream protection administration will be the responsibility of the Protection Section under the direction of the Environment Protection Officer. This will entail providing direction and examination of specific boundaries where the field officer requires assistance. On the basis of examinations on the ground, operational deficiencies will be a matter of early detection, reporting and the use of the suspension procedures to implement corrective action if deemed necessary. Protection Section will be prepared to offer decision, support and direct policy with respect to the P-1 and P-2 clauses in particular.

It is envisaged that the protection administration of the "P" clauses will be dealt with in like manner to the present administration of the "J" clauses.

original signed by
H. M. Pogue
District Forester

EJM:pm1
Enclosures

355 Burrard St.,
Vancouver V6C 2H1

July 10, 1974

M. Protection Sup.

FOR THE INFORMATION OF ALL LICENSEES AND OPERATORS
VANCOUVER FOREST DISTRICT

The District Forester requires that fair warning be given to, and understood by, all holders of cutting authorities and their logging personnel, regarding the policy of stream, stream-bed and/or lakeshore protection. It shall be explained that the cost and consequences of improper planning or operation will henceforth be borne entirely by the forest industry.

The mutual objective of Licensee logging and Forest Service administration to provide protection of streams, stream-beds and lakes can be attained when both Forest Service approval and Licensee supervision are directed, within the prescribed protective strip, not only to cutting and removing wood supplied available according to plan for use by the forest industry but also to maintaining a forest environment suitable for other uses. The forest industry will be penalized for wasting material recoverable from the protective strip under the plan approved pursuant to this policy. The intent of Forest Service administration is to clarify the extent and composition of an acceptable protective strip including trees left standing, which will not be subject to assessment for waste. The forest industry faces penalties, including suspension, possible prosecution, and costly delays involving complicated corrective operations for contravention of the stream, stream-bed and lake protection terms and conditions. In this regard the intent of Forest Service administration is to require that application of suitable logging practices which will do a fail-safe job of felling and removing material subject to assessment for waste. Such removal method designed to leave, in an undamaged condition, a well scattered cover consisting of the remaining trees, brush, and undergrowth growing on the entire width of the protective strip, with negligible ground and soil disturbance. The keys to attaining this result are first, an understanding of what is wanted, and second, an appreciation that logging must be done differently in the protective strip. The protective strip is much more than just an unburned part of the clear cut setting. It is, in fact, more like a specialized version of selective logging, with the particular objective of realistically meeting the legal requirements of the cutting authority stream protection clauses.

It should be stressed at the outset, that the protective strip, along the entire stream, is not necessarily all being logged, depending on the application of planning guidelines, and site specific circumstances. A stream, for instance, could be passing through immature forest, which is not cut, or through a canyon, or past a steep sided cutbank. In other circumstances a section of the stream might consist of intensively used spawning gravel, or through an area being used for forest recreational development. In any event, there will be imminent, or an unlogged buffer zone is deferred, and the question of how to log to obtain a protective strip need not be answered until after the period of deferment is over.

Nevertheless, where logging is active, protective strips will need to be created as part of the logging, along the stream or lakes, and laid out as an outer cutting boundary and an inner boundary defining the width of the strip. In the typical case, the outer boundary will be the stream, and the inner boundary will be marked out along a line approximately averaging one chain away from the stream. In other site specific circumstances, the outer boundary might cross the stream to provide clearance for deflection, etc., or it might be a considerable distance away from the stream, to establish a deferred area, in which case there would automatically be an unlogged buffer strip, as previously mentioned. Where for any reason, the outer cutting boundary is away from the stream, establishing an unlogged buffer strip, then for that part of the stream or lake it should be understood that the outer cutting boundary and the inner cutting boundary coincide.

Within the outer and inner boundaries, which define the protective strip, a number of practices must be applied which in total, make the logging of the strip quite different from the logging on the rest of the setting. First, not all the trees and saplings will be felled. On the other hand, subject to the exemption listed below, all trees which can be incorporated into the harvesting plan, whether standing, pushed over or down, must be logged and removed provided they can be logged and removed without excessively damaging the planned remnant stand of trees and brush. That is to say unless exempted from waste assessment in accordance with stream, stream-bed and lake protection terms and conditions of the cutting authority. The result desired is to create a protective strip consisting of brush, small healthy trees, and any other snags or trees, such as leaners, which were left standing because they could not be felled and logged without unduly damaging the trees and brush, without creating excessive disturbance to the ground, or otherwise contravening the stream, stream-bed, or lake protection terms and conditions. To be specific, no tree or snag can be felled into water or log skidded within the highwater level of any stream channel, and no tree or log can be yarded unless it can be either lifted clear of the ground before it is moved, or high-leaded out in the direction in which it was pointing before being moved. In both cases, can only be moved out on a track clear of obstructions, and clear of the trees and shrubs which are approved to be left standing in an undamaged condition. The result of this practice will in fact be a satisfactory protective strip over the whole of the strip as laid out.

In the course of preparing such a protective strip, considerable value, judgement and close supervision of all logging activities must be exercised. Every tree felled must be felled in the right direction for yaring using jacks or a linehorse to ensure that it is felled precisely to lead in accordance with the rigging layout approved and the pre-planning of tail-block or snatch block location. Trees which cannot be adequately coped with in this way must be left standing, and if they are improperly felled and bucked, they must not be moved until special arrangements are made to re-rig to meet all requirements to the satisfaction of the Forest Officer. Failure to plan and operate properly at any stage will result in suspension of the logging pending corrective actions, and penalty of wastage which would have been avoided by proper planning and proper operations.

It should be apparent the forest industry must accept and overcome in a workmanlike way the challenges of planning and creating satisfactory protective strips, of it expects to economically continue cutting and removing timber from the forests.

District Forester

APPENDIX VI

Fish And Wildlife (Region 1) Comments On The:

- I. Planning Guidelines For Coastal Logging Operations;
 - II. Engineering Specifications For The Planning, Design, Location, Construction And Maintenance Of Logging Roads And Drainage Structures; and
 - III. Ministry Of Forests, Mr. M. Pogue's 1974 Statement Concerning Streamside Logging
-

I. Planning Guidelines For Coastal Logging Operations

General needs:

1. Review the entire coastal situation to evaluate the need to regionalize or even sub-regionalize the guidelines.
2. Stress the importance of water management on steep slopes in association with road engineering and construction. One should prevent amalgamation of creek flows into fewer channels through appropriate use of culverts.
3. Fish do not have to be present on-site to require specific operations around small, steep sidehill drainages for the protection of water quality.
4. No written set of guidelines will replace the need for joint company-agency on-site inspections and management decisions.

Specific Comments:

Section A:

Paragraph 2, Line 9:

Change "game" to "wildlife".

Paragraph 2, Line 13:

Suggested change: "... and they must be recognized and, where necessary, protected". Delete the remainder of the sentence as written.

- (2) Addition: "..., erodable cutbanks and slopes".

- (4) Suggest this should be deleted as no experimental work has shown benefits equal to or near natural deciduous species.
- (6) Suggest inclusion of examples: "... compatible integrated use, such as stream protection and wildlife guidelines";.
- (7) Comment: A leave area does not work as a "filter"; and if left as an economic block in critical wildlife habitat or sensitive fish habitat areas, it should not be planned for harvesting in the immediate future.
- (10) "needed wildlife habitat held pending"
Comment: The time span for "re-positioning into renewed forests" requires definition. Old growth (including snags) may not be a renewable resource.
- (14) Comment: In that a more definitive statement regarding rate-of-cut impacts on the hydrologic cycle of a watershed can not be made at this time, this "50 percent" cut program should be retained. However, the time span between the various cutting passes in a watershed should be defined.
- (15) Suggested amendment: "stream-face, shoreline blocks or floodplains requiring special treatments.

The concepts in the last paragraph of Section A should be clarified:

- stream protection is not identified;
- Line 3, change "game" to "wildlife";
- Line 6 implies a lack of large mature trees for additions of large natural debris to the stream system, snags for birds of prey and cavity nesters, alder as a source of shade, insects and detritus for the stream and, hence, misses the point of stream protection;
- Line 11 suggested addition: "... may include, but not exclusive of". Also one should include debris management and alder management to the list of special measures.

Section B:

It is suggested that the following portion of the last sentence could be deleted: "... and, as a basic guideline, ... factors dictate otherwise".

Section D:

Line 9: The term "phase" should be defined as used in this section. The last sentence, "At no time during the same ... has been assured.", should be deleted.

Section E:

Line 3: Suggested change: "Setting boundaries ... shall be located with water courses in mind so that"

Line 6: Use of the word "stream" requires definition so that one understands the type of stream that requires "special measures" and to what degree.

Section F:

Line 4: Change "... stream-bank clean-up ..." to "streambank protection"

Section J:

This section by and large is repetitive of the Vancouver Region Minimum Road Specifications and could be replaced with a reference to adherence to those road specifications.

II. Engineering Specifications For The Planning, Design, Location, Construction And Maintenance Of Logging Roads And Drainage Structures In The Vancouver Forest Region

A. Engineering Policy

A.2 1. "... slide areas, marshes and active floodplains;"

A.3 Comment on the use of end hauling. This sedimentation minimization technique should not be considered "special" or "unusual" but rather a standard requirement wherever sidecasting will impact on streams or wet gullies.

B. Minimum Road Specifications

B.3 Suggest addition of new points:

5. During grubbing operations the over burden material should not be deposited into seasonal or perennial flowing gullies.
6. R/W falling should be away from water courses unless authorized by the Forest Officer in consultation with federal and provincial fisheries agencies.

B.4 Suggest the following be added: "Where the nature of the ballasting material creates a siltation problem, then the normal ballast material should be replaced with crushed rock."

D. Bridges

3. Suggested addition: "Pass the ... major tributaries; design not to encroach upon high water wetted perimeter."
5. Suggested addition: "Satisfy ... environmental damage; design to include brow logs on mud or gravel surfaced culverts and bridges."

E. Culverts

Suggest addition of the following points:

- E.10 Log culverts or multiplate/pipe arches to be used on fish bearing streams;
- E.11 Install brow logs on all large culvert installations.

Comment: Forest Service should define the maximum stream size that can be crossed by use of culverts. Any watercourse above that size would require a proper bridge crossing.

F. Special Provisions For The Maintenance Of Water Quality

Suggested changes and additions:

- F.8 "Suspend any road building ... causing potential erosion"
- F.13 End haul where necessary to keep materials out of wet gullies and/or streams.

G. Special Provisions For The Protection Of Fish Bearing Streams

- G.1 Suggested addition: "Obtain the approval ... fish bearing streams and non-fish bearing streams which have the capacity to impact (siltation or debris movement) on downstream fish habitat."

III. Ministry of Forests, Mr. M. Pogue's 1974 Statement Concerning Streamside Logging

See attached letter to Mr. D. Grant, Regional Manager, Vancouver Forest Region, suggesting items that should be considered in a proposed re-writing of the 1974 statement.

MT Howland
for

D. C. Morrison
Regional Habitat Protection Biologist

DCM:bms
bcgeu
Enclosure
21 Oct 82





Province of
British Columbia

Ministry of
Environment
- 60 -
Fish And Wildlife
Branch

Vancouver Island Region I
Regional Headquarters
2589 Kenworth Road
Nanaimo
British Columbia
V9T 4P7
Phone: (604) 758-3951

4 June, 1982

0155/ Alder Mgmt.

B. C. Forest Service
355 Burrard Street
Vancouver, B. C.
V6C 2H1

Attention: Mr. D. Grant, Regional Manager

Dear Sir:

RE: Proposed Forest Service Circular Letter To Companies Regarding
Riparian Habitat Management Adjacent To Foreshore, Lakes And Streams

It was agreed at the 8 March, 1982, meeting that Fish And Wildlife and Federal Fisheries would supply the Forest Service with notes and points for inclusion in revised Circular Letters to all Licensees. The following information has been agreed to by our Fisheries Section and M. Brownlee of Fisheries & Oceans.

Note: Although the text refers to streams, these guidelines are also applicable to lakes and, in certain cases, the foreshore.

1. Circular Letter regarding management of streamside deciduous species

1.1 Introduction: State why alder, and to a lesser extent other deciduous species, are important to productivity of stream ecosystem, i.e.,

- alder and/or heavy leaning coniferous trees left after logging are required as eagle perch trees, cavity-nesting sites, and habitat for furbearers. These trees will also provide a future source of critical large natural debris for maintenance of habitat diversity within the stream channel;
- important contributors to nutrient cycles, i.e., provides energy in the form of detritus for production of fish food organisms, and provides a source of terrestrial insect fall into streams;
- provides streambank stability and erosion control;

B. C. Forest Service
4 June, 1982

- provides necessary shade and cover at certain sites.

1.2 Deciduous Species Management
(Alder) during pre- and post-logging phases

- do not cut, kill or girdle deciduous species along banks of fish-bearing streams prior to logging or in post-logging treatments within a zone defined by the following:
 - i. a five metre strip adjacent to the stream, and defined swamps draining into the stream;
 - ii. from the top of the defined streambank down to the stream, or
 - iii. within the high water wetted perimeter where erosion control provided by alder and other deciduous species is required,

using whichever defines a protective zone of greatest width. Alder removal may be permitted on small (less than three metres) tributaries, side channels or back channels occurring within a "high-site" flat;

- carry out block layout and logging as per the existing P1 and P2 clauses, as we are basically satisfied with the current field results. There is a need to stress the use of directional falling techniques in areas where blowdown warrants removal of all merchantable trees, excluding heavy leaners. Conifers with a heavy lean or non-merchantable trees should be left as a future source of large organic debris to the system. Site specific deviations from the above standard prescriptions can be handled at the time of inspection through consultation between the Forest Officer and Fisheries' agencies.

1.3 Management of streamside deciduous species during all phases of intensive silvicultural programs

B. C. Forest Service
4 June, 1982

- in conifer release programs carried out shortly after logging/planting operations the deciduous streambank species protected during logging and those regenerating after logging (within the zones defined in 1.2 above) are to be left undisturbed,
- in forest site rehabilitation projects, consider the following site-specific management options:
 - i. as a general rule, leave deciduous species within five metres of all fish-bearing systems. One exception would be where alder removal is permitted during rehabilitation operations along small (less than three metres wide) tributaries, side or back channels occurring within a flat "high site" area. In these locations, the lesser shrub species would provide detritus, insects, etc., to the system;
 - ii. in areas where the streamside and adjacent sites are solid alder throughout the length of the fish-bearing portion of the stream, alder may either be taken to within one to five metres of the stream, or to the stream edge, if taken over a time phase sequence. This is conditional on:
 - leaving high stumps to promote the regrowth of sprouts,
 - the stump is not killed, and
 - debris will have to be removed if it enters the channel as a result of this operation;
 - iii. not withstanding the above, alder should not be disturbed where it is contributing to either erosion control or protection and stabilization of the streambank.

B. C. Forest Service
4 June, 1982

2. Proposed revision of the Circular Letter discussing P₂ clause logging

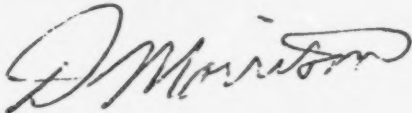
We agree that the Circular Letter originally sent out by Mr. M. Pogue is out of date. "Selective logging" within a 20-metre strip adjacent to streams is not occurring in the field, and perhaps justifiably so in many circumstances. We suggest that the following points, currently being considered in the field, could be more appropriately included and stressed in a revised letter:

- deciduous trees and shrubs are to be protected along fish-bearing watercourses, unless where authorized for removal through consultation with Fisheries agencies and Forest Service. This would eliminate the increasing occurrence of unauthorized girdling of alder in advance of harvesting timber blocks;
- the need for application of directional falling techniques to achieve environmentally sound removal of merchantable wood adjacent to watercourses. Non-merchantable trees or heavy leaners should be left as a future source of large organic debris, raptor and cavity-nesting habitat, and furbearer habitat;
- timber blocks layed out so as to yard away from sensitive watercourses. "Sensitive" watercourses are defined as those having fish on-site, and/or a channel and banks capable of generating silt due to disturbance, and/or the flow capacity to move and relocate instream debris. Cross-stream yarding (above-stream yarding) will only be considered in situations where it is environmentally safe;
- the need for removal of large and fine logging debris which enters a watercourse capable of shifting the debris or transporting it downstream of the site;
- the need to schedule falling, yarding and debris clean-up along sensitive streams to coincide with periods of seasonal low stream flows.

B. C. Forest Service
4 June, 1982

It is understood that the above points will be taken into consideration during the drafting and/or redrafting of the appropriate Vancouver Region Circular Letters. It would be appreciated if the drafts could be circulated to Fish And Wildlife Branch and Federal Fisheries for review prior to a follow-up discussion meeting.

Yours truly,



D. C. Morrison
Regional Habitat Protection Biologist

SMJ:bms
bcgeu

- cc M. Brownlee, Fisheries & Oceans, Vancouver
B. Cox, Regional Habitat Protection Biologist, Surrey
C. G. Prouse, Regional Manager, Fish And Wildlife Branch, Nanaimo
J. C. Lyons, Regional Director, Ministry of Environment, Nanaimo
J. Walker, Chief of Habitat Management, Victoria
G. E. Reid, Regional Fisheries Biologist, Nanaimo
All Habitat Protection Technicians
J. Louie, B. C. Forest Service, Vancouver
G. Ursel, B. C. Forest Service, Vancouver
G. Kennah, B. C. Forest Service, Vancouver





Province of
British Columbia

Ministry of
Environment

- 65 -

APPENDIX VII

Vancouver Island Region I
Regional Headquarters
2569 Kenworth Road
Nanaimo
British Columbia
V9T 4P7
Phone (604) 758-3951

March 11, 1983

SEE DISTRIBUTION LIST

Re: Tsitika Fisheries Prescription Guidelines

Sorry for the delay in sending out this "corrected" copy of the attached guidelines, after the last TFC meetings, for your information and use in the field.

The Guidelines were approved by the TFC for a six (6) month trial period. After this period they will again be discussed at a TFC meeting.

Yours truly,

D. C. Morrison,
Regional Habitat Protection Biologist

DCM:mvp

cc C. G. Prouse, Regional Fish & Wildlife Manager

Fisheries Prescription Guidelines
for Non-anadromous Streams in the
Tsitika Watershed

INTRODUCTION

The following guidelines have been developed in response to operational problems encountered by the Forest industry in the implementation of the Tsitika Plan. The problem is essentially one of interpreting the wording and intent of the Tsitika Resource Plan fisheries prescriptions, relating to smaller non-anadromous streams. The intent of the present guidelines is to minimize sedimentation, manage debris and maintain channel stability.

These guidelines will assist local Company and Agency staff in making logging decisions related to protection of these stream channels site-specifically in the field. Non-anadromous streams include all streams not frequented by anadromous fish, whether they support resident fish or not. We anticipate variations and flexibility in the application of these guidelines based on joint site-specific investigation, provided the intent of the plan is achieved.

Application of the guidelines in the field during a suitable trial period will be through site-specific inspections. At the end of this period, the TFC will review

the guidelines, and if approved, a paper will be prepared for public review. Following this, the TFC will forward its recommendations and the public comments to ELUC for final approval, resulting in a supplement to the Tsitika Plan. If there is disagreement on logging prescriptions for a streamside block during the trial period, the issue will be referred to the TFC for a decision.

To attain the objectives of the Guidelines, there is a need for a high level of supervision during all phases of the field operations. Continued use of the Guidelines will be contingent upon their effectiveness in protecting the fisheries resource and the performance of the forest industry in carrying out the prescriptions, while at the same time permitting logging of the Tsitika watershed in accordance with Workers' Compensation Board safety regulations.

Monitoring programs and procedures will be established by the companies in consultation with the Agencies to evaluate debris and stability of selected channels. This will be required pre, during and post treatment to evaluate guideline effectiveness.

The major factors to consider when carrying out on-site inspections to establish logging prescriptions on non-anadromous streams are: a) the potential for utilization by fish, b) ability of the stream to transport debris, c) the

potential for sedimentation due to logging on sensitive soils and d) the potential for problems associated with blowdown.

Prescriptions for Non-Anadromous Streams

1) Streams greater than one meter

Tsitika Fisheries Prescriptions to be adhered to, unless there is no concern with soil/bank erosion, debris movement, and the stream does not support fish. These latter streams may be handled by referring to prescriptions under Point 2 which follows.

2) Streams less than one meter wide

- a) Consider leaving a windfirm buffer if there are numerous channels in close proximity in the block.
- b) Falling and yarding away from stream channels will be required when: i) on perennial streams the gradient is less than 10% (therefore potential resident fish habitat), ii) the operation has the potential to create a sedimentation problem, iii) there is the potential for movement of logging debris which cannot be removed from the channel, or iv) there is potential for damage created by blowdown.
- c) Falling and yarding above a stream may be possible when: i) there is no potential for debris movement, ii) where logging debris can be removed from the channel in cases where the stream has the capacity to

flush, iii) there are no potential sedimentation problems and iv) where there are either no fish present or there is potential for fish utilization (< 10% gradient), but the stream has only seasonal flow and the operation is scheduled for the dry period, and it will not create any sedimentation and there is adequate deflection to prevent physical damage to the stream channel.

Such operations are subject to timing constraints, and handcleaning of introduced unstable debris (including accumulations of fine debris*) will be necessary when the streams have the capability to move debris.

Non-anadromous streams with no potential for fish production in the future, flowing directly to the ocean will require less protection than those flowing into fish bearing streams.

Other Considerations

Notwithstanding the above, trees which are dangerous to fall or those which can not be handled with directional falling equipment should be left to provide large natural debris for the channel in the future. If, however, the area is subject to severe blowdown or if the trees have to be

* Fine debris refers to needles, leaves and twigs.

removed to permit safe yarding, then consider the following options:

- (i) fall across the channel, but no delimbing of trees above or immediately adjacent to the channel,
- (ii) either "yard out" by a method that will prevent bank and channel disturbance or leave a length of the stem (a "bridge") across the channel in a stable position, then buck and yard the remainder of the stem away from the channel,
- (iii) where topographic or soil conditions suggest that neither yarding nor bucking is acceptable then consider falling and leaving the entire stem as a means of preventing blowdown damage, and
- (iv) timing restrictions on the operation, together with the need for and the degree of debris clean-up required.

Summary

If found to be practical and effective, it is proposed that these guidelines be forwarded to ELUC for approval. if approved, they will then be inserted into the Tsitika Plan as a supplement, cross referenced to page numbers in the Plan. The Plan will then have to be amended to enable us to utilize the guidelines site-specifically in the field by the inclusion of the following statement:

"Decisions on stream-side logging prescriptions for

small non-anadromous streams will be made by company and agency field staff using the supplemental guidelines during joint on-site field inspections of those blocks for which the Tsitika Plan fisheries prescriptions were deemed inappropriate."

DCM/SMJ:mvp

Stream Characteristics					Logging Treatment	Clean-up Requirement
Fish present, or potential (< 10% gradient)						
X				X	Leave a windfirm buffer.	--
X			X	.	Fall away and yard away, or fall problem trees directly across and either leave the entire tree or a portion of the tree "bridging" the channel in a stable fashion.	Mandatory cleanup of any debris that enters stream during logging. Handcleaning of fine debris.
X			X	X	If the channel is dry at the time of the operation and there is adequate deflection to prevent physical damage to the stream then falling across and yarding above may be permitted. If it is flowing at the time of operation, then fall away and yard away.	As above.

NO SOIL/BANK EROSION PROBLEM
SENSITIVE, ERODIBLE BANKS
NO DEBRIS MOVEMENT POTENTIAL
CAPACITY TO FLUSH OR MOVE DEBRIS
SAFETY HAZARD, OR BLOWDOWN
EXPECTED AS A PROBLEM
NUMEROUS CHANNELS IN CLOSE
PROXIMITY
FLOW IS SEASONAL ONLY

Stream Characteristics	Logging Treatment	Clean-up Requirement
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No fish present and no potential as Fish Habitat (> 10% gradient)

X		X					Fall and/or yard across.	Debris cleanup generally not required.
X			X				Fall and/or yard across, timing constraints may be necessary on logging operations. i.e. during low flows.	Debris cleanup required prior to fall freshet.
or	X	X				X	Consider leaving a windfirm buffer if the soil problem is a Class 5 situation or if there are numerous channels in close proximity in the block.	--
	X	X				X	Fall away and yard away from, timing constraints may be a factor. Where trees have to be felled across, yard out only if deflection and equipment will permit them to be lifted off the channel. If this can not be done, then leave a portion of the stem across the channel as a "bridge" in a stable fashion.	Cleanup generally not required.
	X		X		X		As above, but carry out operation during low flows.	Debris cleanup required prior to fall freshet.

POOR

QUALITY

ORIGINAL

